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ELECTRICAL HAND LABOR.

Aptly compared by Manager Bruch, of the Postal, to a bad storm in its effects, the telegraph strike is now on. In some way the operators had the strike fever in their veins, and would not be happy until their vague discontent had thus found violent expression. Only a few months ago, they were given a 10 per cent increase in pay, but now appear to be asking for more in the shape of another 15 per cent and an 8-hour day; although the real grievance would also seem to be the alleged ill treatment of nine Western Union men discharged "for cause," including drunkenness and insubordination. As a matter of fact, the Postal men had no personal grievances, but went out sympathetically and without any warning. The union leaders were unwilling to order a strike, but the younger hotheads who do not remember the disastrous days of the early eighties forced the situation on them.

The strike will soon be over, for even if it had better warrant, men who serve the public so intimately have no right to make their attempted redress of injustice with utter disregard of business and social necessities and of the public convenience. As a matter of fact, it is a pity the strike is not more thoroughgoing, as then the telegraphic managements would be more forcibly compelled to abandon hand labor and take up the various automatic systems that are so eminently worthy of adoption to-day. We should be heartily glad to see every operator improve his condition, but he can best do that by abandoning the key utterly. There is little expansion and less profit in the telegraph industry of to-day, and on a basis of manual toil, the companies cannot afford to raise wages very much if at all beyond the present point. It is a great pity, we repeat, the operators cannot see the economic conditions that beset their drudgery.

FREQUENCY SINGLE-PHASE RAILWAYS.

At the present time, we have in America two standard alternating-current frequencies, namely, 60 and 25 cycles-per-second. There are, however, a number of other frequencies in commercial use in America, such as 30, 40, 50, 125 and 140 cycles-per-second, which, at the time they were installed, were perhaps considered as likely to remain standard as any others. As regards the existing standards, it would have been better if they had been 25 and 50, instead of 25 and 60; but it now appears hopeless to make a change in this direction, notwithstanding the handicap in foreign trade that the latter frequency imposes. The amount of capital invested in machinery and systems of 60-cycle frequency in this country is comparable with the amount of capital invested in the rolling stock and roadbed of railroads with 4 ft. 8½ in. gauge, which is so large that there is not the least hope of changing this gauge, say, to 5 ft. 6 in., although it is said that the existing gauge was adopted by a mistake. It is possible that a single frequency

such as 30 cycles per second, might have been adopted as a universal standard for all classes of electric light or power transmission and distribution, if it had not been for the sensitiveness of the eye to flicker of light at luminous frequencies lower than 60 cycles-per-second. It has recently been demonstrated that flickering illumination of stationary objects must be very powerful if the flicker is detectable by the eye at rest when the frequency of flicker reaches 50 cycles-per-second or more. This frequency is reached by incandescent lamps at an alternating-current frequency of 25 cycles per second, because there are two flicker cycles to each alternating-current cycle; but it is not reached by arc lamps until the alternating-current frequency attains 50 cycles per second, because the brightnesses of the anode and cathode are not alike, and this difference in brightness produces a flicker frequency equal to that of the alternating current. Consequently, it has been necessary to use a frequency of 60 cycles per second for the successful operation of arc lamps whose carbons added largely to the light of the arc itself. If arc lamps had confined all their light to the arc flame, with its two cycles of flicker to each alternating-current cycle, it might have been possible to operate them satisfactory at 30 cycles per second.

It is now seriously proposed to add another frequency to the list, say, at 15 cycles per second, so as to make the list 60, 25 and 15. This is for the sake of the recently developed single-phase series-motor, for interurban and electrified steam railroads. Two papers on this subject were presented at the Niagara Falls convention of the American Institute of Electrical Engineers. One of these papers was in favor of adopting the proposed new frequency, while the other was opposed to the addition. It is admitted on both sides that the output of an alternating-current series motor is increased by lowering the frequency from 25 to 15 cycles per second, although the amount of increase is a matter of difference of opinion, those in favor of the change claiming 30 per cent to 35 per cent, and those opposed claiming only about 15 per cent. It is also agreed on all sides that the reduction in frequency would involve an increase in the size and weight of the generators at the power houses and of the transformers, both step-up and step-down.

The question at hand is whether a certain percentage more motor power can be placed on a single-phase locomotive sufficient to pay for the inconvenience and expense of a change in frequency. The question is a serious one from the standpoint of the future, although not a serious one from the standpoint of the present. Railroads, more than any other engineering structures, must correspond, and be built to standards. If one large railroad should become electrified at a frequency of 15 cycles per second, it would probably necessitate the sequence of future roads on the same frequency. It would then probably be too late to retrace steps, or change the frequency. Just as the 4 ft. 8½ in. gauge is practically universal in America, so the frequency for alternating-current railway traction would probably have to be. It is, therefore, necessary to proceed with great care when passing judgment on new standard frequency. If the frequency of 25 cycles per second did not exist, the frequency of 15 would still be too low for good incandescent lighting with high-efficiency lamps, owing to the flicker, and it would *a fortiori* be too low for arc lamps. Only dire commercial necessity, or Hobson's choice, should bring the frequency of 15 cycles per second into use.

The Electron Rampant.

The recent British Association meeting seems to have been a mild understudy for Donnybrook Fair in the sections where physicist and chemist waged the battle of the electrons. Sir Oliver Lodge proclaimed the atom squirming with electrons, a simile that quite irresistibly suggests a bit of ancient cheese; while Lord Kelvin threw the weight of his authority upon the other and more conservative side of the question. We have from time to time presented something of the evidence both for plaintiff and for defendant and can even now only reiterate our advice to go slowly and to sift the facts without bias. Hypotheses on the nature of matter run back clear to the Greek philosophers, but so far they have remained only hypotheses, often stimulating and helpful, but never rising even to the rank of probable fact. It is not in the least necessary for a hypothesis to be literally true in order that it may be useful in directing research toward valuable discoveries. It would be difficult to mention any proximate doctrine that has been more important to theory and practice than the splendid and fruitful speculation of Kekulé, and yet in view of the work of Van t'Hoff and his successors no chemist would seriously defend the thesis that the carbon atoms in a molecule of benzol are literally arranged in the conventional hexagon. It is quite sufficient that they behave in many respects as if they were actually hooked together with valences.

As with the molecule so with the atom. For more than a quarter-century past it has been perfectly well understood that the atom must be dynamically complex and the epoch-making work of the lamented Mendeleéf left little doubt in the mind of any serious thinker that the so-called elements are in some way structurally related. No definite light on the nature of that relation has yet appeared, in spite even of the admirable discoveries of Sir William Ramsay regarding helium. When it becomes possible to deal with the element radium, pure in the ordinary chemical sense, and to derive helium from it, a vast step in advance will have been taken, but just that step is as yet lacking. It is well to remember that no man has yet seen radium, and that all the properties attached to the name belong really to haloid salts of radium, contaminated with unknown impurities. The relation of this mixture to the so-called "radium emanation" remains as yet undiscovered, and while the appearance of helium in the emanation is definitely proved, its relation thereto is a matter of speculation rather than of certainty. If helium really is a true decomposition product of radium or of any other quasi element no one will be greatly surprised, and the only regret will be that the result was not obtained by a process of more general applicability. Certainly the matter is in the hands of an investigator who is both capable and cautious, which is more than can be said of some of the hustling experimenters who have butted into the field of radioactivity. This phase of the question, depending as it does upon exact investigation, can be safely left to take care of itself in due season.

As to the electronic theory of matter, it works out very prettily up to a certain point, like other theories of matter, and then gets into trouble. If one postulates subatomic particles endowed with any plausible set of properties, their interactions can be made to fit a large number of the more general properties of ponderable matter, as witness various speculations from the day of Æpinus up to date. We have had Maxwell's idle-

wheels and the vortex atom and a few others within recent years, and it does not help the matter much to call the fundamental unit chosen "electricity." Truth to tell, there is very little known experimentally about the electron and until more is found out about its dimensions and relations, its derived properties are of secondary interest. Those whose experimental knowledge is the most direct and precise are the least disposed to slop over into hasty generalizations. This much is clear, that a sufficient breach has been made in subatomic dynamics to justify an assault in force, which, whether it succeeds now or a century hence, can never wholly be driven back. But it needs determined leadership and all the resources at the command of science. Great experimenters are particularly needed just now and they are painfully scarce. There is a tendency toward rushing into print with work half completed and ill done that is perhaps in keeping with the spirit of the times, but which accords ill with scientific conscientiousness. The mystery of the structure of matter is, save the mystery of life, the greatest which science has to face, and any light that can be thrown upon it is clear gain. But it is altogether premature to suppose that either can be penetrated by changing the terminology of the philosophic conceptions, and that is about all that speculations past or present have been able to accomplish. In the existing premises, science does not need Lucretius or Kant, but the inspired aid of Newton and Faraday and Helmholtz; and upon whom has their mantle yet fallen?

CHARACTERISTICS OF SYNCHRONOUS ALTERNATORS.

One of the papers presented at the recent Niagara Falls convention of the American Institute of Electrical Engineers was on the "Interaction of Synchronous Machines," by Prof. Morgan Brooks, and considers the relations of current, voltage, power and phases, of two single-phase machines running together in synchronism. The treatment is essentially graphical, and lends itself excellently to the case of a constant-potential alternator, driving a motor on which the load varies, or of which the excitation may vary. The diagram is made by drawing a base line of length representing the generator voltage, and a direction line at each end, making an angle therewith equal to the antitangent of the reactance-factor of the circuit. These two lines will intersect at a point which is called the center of the diagram. Any concentric circle about this center is the locus of the vector motor c. e. m. f. for a corresponding constant power imparted to the motor. So much at least of the diagram has been already worked out by Blondel. The new graphical contributions of the paper are certain additional loci to the Blondel diagram, such as a system of internal osculating circles for constant motor efficiency or constant heat loss. There can be no doubt that the circle alternator diagram is the simplest key to the operation of a variable motor working on constant-potential mains, just as the rectilinear alternator diagram, also first given by Blondel, is the simplest key to the operation of a synchronous motor on a circuit of variable potential. Without these diagrams, there is nothing to guide the mind's eye but a mass of algebraic formulas. With the diagrams, each and every varying factor can have its individual influence noted and taken into account.

The paper calls attention to an interesting fact not generally known; namely, that the initial impedance of a synchronous machine when its main switches are first closed may be much less than its synchronous impedance. That is, the current which may flow through an alternator armature when first switched on to the bus-bars near synchronism may be much greater than the current which will flow through the system, for the same phase difference, after the machine has been running in parallel. This is probably due to the fact that the synchronous impedance of a machine is much greater than its simple impedance, owing to the influence of armature reaction in modifying the generated e. m. f. When the armature of the incoming machine is first switched in, the simple impedance only is effective, and the effect of armature reaction is delayed by the hysteresis of the magnetic circuit for perhaps a second, or many cycles, during which a dangerously powerful current may flow. It is very important that series of measurements should be made with synchronous alternators, under practical conditions, to ascertain how closely their synchronous impedance is maintained uniform throughout the range of their synchronous operation. All of these useful graphical methods depend on this constancy of synchronous impedance for their precise application. It is generally hoped and believed that the constancy substantially exists, but the experimental support for the belief seems incomplete and this objection was pointed out in the discussion of the paper.

One of the most interesting and valuable properties of a synchronous motor is its ability to draw from the supply system a wattless component of current of either a positive or a negative value, according to whether its field excitation is above or below a certain degree. Thus the current taken by the synchronous motor is not dependent solely upon the load as is the case with the induction motor, but it varies largely with the field current. These facts are clearly shown in the diagrams given in the paper noted above. Some little use has already been made of the synchronous motor for absorbing leading wattless current and thus for compensating for the lagging wattless current demanded by induction apparatus, and it is probable that the future will witness an increasing application of the "synchronous condenser." Our last issue contained an article by Mr. Clarence P. Fowler discussing in detail the conditions which render desirable the compensation for wattless lagging currents, and explaining the operation of a synchronous machine exclusively as a "rotary condenser" and also as a combined motor and condenser. The article shows that the latter operation is of greater practical value than the former. Neglecting certain minor modifying influences, the facts may be outlined as follows: If instead of buying a 1000-k. v. a. "rotary condenser" the purchaser selects a 1414-k. v. a. synchronous machine, he obtains simultaneously the desired rating in a synchronous condenser and an additional rating of 1000 kilowatts in a synchronous motor. Moreover, the 414 k. v. a. increase in the rating of the synchronous machine should cost somewhat less per k. v. a. than the 1000 kilowatt rating in a synchronous motor. It would seem that an increase of 40 per cent in the investment for the combined motor and condenser apparatus might be equivalent to 100 per cent increase in the investment for separate motor and condenser equipments. The actual saving obtained depends largely upon the relative values of the motor and condenser loads and upon the power factors, a particular example being worked out in detail in the article in our last issue.

Electrification of the New York, New Haven & Hartford Railroad.

In view of the numerous discussions that have arisen concerning the adoption by the New York, New Haven & Hartford Railroad of single-phase locomotives for hauling its trains throughout the "electric zone," we are pleased to be able to give below the reasons assigned by Mr. E. H. McHenry, vice-president of the N. Y., N. H. & H. R. R. for the selection made by the company. The electric equipment which was placed in successful operation during the present month, has been described by us from time to time as the work of installation progressed. The locomotives were treated quite fully in our issue for April 14, 1906, while our issue for March 30, 1907 contained a brief description of the catenary line work. Additional information concerning the overhead system is given elsewhere in this issue.

The act of Legislature of May 7, 1903, of the State of New York, providing for the future regulation of the terminals and approaches thereto of the New York & Harlem Railroad in the City of New York, authorizes the New York Central & Hudson River Railroad Company and the New York, New Haven & Hartford Railroad Company, lessees of the New York & Harlem Railroad Company, "to run their trains by electricity, or by compressed air, or by any motive power other than steam which does not involve combustion in the motors themselves" through the tunnel and over the tracks more specifically described. The act requires that the change of motive power be made on or before July 1, 1908, and provides a penalty of $500 per day on and after that date for failure to comply with its terms.

As there was no available form of motive power other than electricity which met the conditions of the act, it accordingly became necessary for the N. Y. C. & H. R. R. R., and the N. Y., N. H. & H. R. R. to provide suitable locomotives, power houses and track equipment for electrically operating all trains between the Grand Central Station at Forty-Second Street and the prescribed sub-limits within the limits of the City of New York.

The terminal tracks of the New York & Harlem Railroad, between the Grand Central Station and the junction point at Woodlawn, a distance of 12 miles, are jointly leased and operated by both the Central and New Haven companies. The zone of electric operation on the lines of the latter was further extended 21 miles, to Stamford, to include the greater number of its suburban trains.

This feature of joint operation more than all others restricted and narrowed the latitude of choice in the selection of a system of electric traction by the New Haven company. The Central company was first in the field, and having previously adopted a system based on the use of continuous-current motors taking current from a third rail, it was obvious that no method inconsistent with such conditions was open to the New Haven company, and it was thus practically confined to a choice between continuous-current low-voltage system as adopted by the Central company and a more recently perfected high-tension single-phase system. The first has been in general use for a number of years and, as installed by the Central company, includes the generation of alternating currents at 11,000 volts and 25 cycles, high-tension transmission to sub-stations located approximately five miles apart, at which points it is transformed by transformers and rotary converters to continuous current at 666 volts. The current is supplied to the engine contact shoes through a secondary system of distributing feeders and an inverted third rail of improved type. Continuity and regularity of operation are further insured by a large and most noteworthy installation of storage batteries in each sub-station.

The single-phase system is the latest and most advanced step in the evolution of electric traction, and it was not until 1904 that the first commercial installation, on the Cincinnati & Indianapolis Traction Company, was operated. With this system, electric power may be generated, transmitted and supplied directly to the electric locomotive, substantially at the initial frequency and voltage, without intermediate reductions or transformations of any kind. In effect it duplicates the simplicity of the local street railway operating with continuous currents supplied directly to the motors from the trolley line. It avoids all necessity for the ordinary equipment of transformers and rotary converters, storage batteries, low-tension switchboards, and low-tension distributing and contact conductors, while affording the flexibility and economy of high-tension alternating-current transmission over long distances.

The characteristics of the single-phase motor are essentially identical with those of the more familiar continuous-current series motors. Single-phase series motors are adapted for operating with either alternating or continuous currents, and this valuable feature makes it possible to design locomotives which may be operated at will by high-tension alternating currents from an overhead conductor, or low-tension continuous currents from a third rail.

The New Haven railroad company was one of the pioneers in the field of heavy electric traction, and has operated six of its shorter branch lines by electricity in commercial service for a number of years past, beginning as early as 1895. Three of these lines, aggregating 33 miles in length, were equipped for overhead contact, and the remaining lines, aggregating 39½ miles in length, for a third rail contact. All lines were operated with 500-volt continuous-current motors, supplied from main stations and sub-stations of the familiar type. The third rail was rather primitive in form and without protective devices of any sort. So many fatalities and injuries followed the use of this method of supplying current to the motors that the railroad company was compelled by a decree of the Superior Court dated June 13, 1906, to abandon all third-rail operation in Connecticut and revert to steam service, and it now has no third rail in service excepting a junction overlap with the New York Central road at Woodlawn. Improved methods of protecting the third rail are available which considerably mitigate the more dangerous features of the earlier installations, but the unfortunate and unsatisfactory experience of the railroad company with this type of construction influenced its decision in favor of the single-phase system, which was finally adopted after a careful and complete investigation of the relative merits and disadvantages of the two methods of construction.

Had the study of the problem been limited to the equipment of the terminal section in New York City, considerations of uniformity and expediency would doubtless have influenced the decision in favor of continuous-current motors, taking current from a third rail. The New Haven company, however, recognized the great importance of its decision in its far-reaching effect upon future extensions of electric service to other parts of its system, and the final decision was based upon a study of the subject as a whole rather than upon the solution of the terminal problem only.

While both of the methods under consideration included high-tension transmission by alternating current, it was believed that the combination method requiring transforming devices and continuous-current motors was less well adapted to the conditions than its simpler single-phase competitor, for many reasons. The electric efficiency of the combination system between power house bus-bars and engine shoes is only 75 per cent, as compared with 95 per cent for the single-phase system. The flexibility of the former is impaired by the limited radius of the secondary low-tension distribution, thus requiring sub-stations at frequent intervals, and still further by the limitations imposed by the use of a third or conductor rail. The position and height of this rail in its proper relation to the track rail must be rigidly maintained, and the practical margin of permissible variation is measured in fractions of an inch. Also, its continuity is broken at switches and crossings by frequent transference of the conductor rail to the opposite side of the track or to an overhead position. In contrast, the single-phase system requires no sub-stations or secondary circuits; the continuity of the overhead conductor is complete, and its position and height may vary within vertical and horizontal limits of eight feet and four feet, respectively, without

losing contact with the collecting shoes on the pantagraph frames.

It is yet too early to furnish definite and positive comparisons of cost of the two methods under consideration, but the calculations and experience of the railroad company's engineers indicate that the total cost of a single-phase installation will be much less than that of the continuous-current system, and that the higher electrical efficiency, lower fixed charges, maintenance, and operating expenses of the single-phase system all tend to reduce the relative cost of energy delivered to the engine shoes in about the same proportion.

The determination of the most economical and desirable frequency and voltage of the transmission system involved the consideration of many factors entering into the problem. The choice of frequency was practically fixed by the manufacturing companies within limits of 15 and 25 cycles, and the comparative merits of only these two frequencies were considered.

The lower frequency afforded a material reduction in weight, size and cost of motors, a reduction in conductor losses and induction disturbances, together with an increase in the power factor of the motors. On the other hand, its adoption would have materially impaired the commercial value of the system as a whole, in restricting or preventing its extension for many other uses incidental to railway operation. The standard power and railway frequency in general use is 25 cycles, and as the New Haven company already owned a number of power houses generating at this frequency for standard trolley operation, and, in addition, had equipped many of its shops with 25-cycle motors, the adoption of 15 cycles would have required the abandonment of a large amount of standard apparatus, or the interposition of costly and inefficient means of translation. The lighting of stations and other buildings was quite an important factor, as 25 cycles is the lowest frequency at which the carbon-filament lamps in general use can be satisfactorily operated. It was also considered desirable to provide for operation in parallel with the 25-cycle generators already adopted by the New York Central company. The practical effect of a change from 25-cycle to 15-cycle apparatus was thus substantially equivalent to a "break of gauge," and under existing conditions it was decided that the practical commercial value of the higher frequency outweighed the more theoretical merits of the lower one.

Various alternatives were considered before fixing the generating and transmission e. m. f. of the system. It was at first proposed to increase the economical radius of transmission to the utmost by generating at the highest initial voltage for which alternators could be safely designed (about 22,000 volts) and to provide sub-stations at suitable intervals, equipped with stationary transformers, for supplying current at 3000 or 6000 volts to secondary contact circuits. As the two motors in each electric locomotive truck are permanently connected in series, current must be supplied at 560 volts through the transformer forming a part of the locomotive's equipment.

It became evident, however, that a great gain in simplicity would result if the intermediate sub-stations and line transformers could be omitted altogether, and further study demonstrated the possibility of effecting this by reducing the initial e. m. f. to 11,000 volts and raising the ratio of the locomotive transformer to correspond. This plan was carried into effect with a resulting reduction in the capital and operating cost, coupled with an increase of electrical efficiency, which proved most gratifying. Incidentally, the difficulties in designing satisfactory collecting devices were greatly diminished.

The difficult and responsible task of determining and analyzing the operating conditions and the requirements was assigned to Mr. Calvert Townley, consulting engineer, and Mr. William S. Murray, electrical engineer, of the New Haven company, to whom, together with their able assistants, credit is due for the design, supervision and successful execution of the many and difficult details of this novel installation.

The following comments by Mr. McHenry upon the commercial aspects of electric traction are interesting in view of the natural prejudice of the stockholder in favor of the continued maintenance of dividends which must be respected, and because the technical expert too frequently neglects this aspect in his scientific ardor for the building of monuments of engineering skill and achievement:

Numerous analyses and comparisons of the comparative costs of electric and steam operation have been published from time to time, which tend to prove that a considerable saving of fuel, engine repairs and other operating expenses may be expected. Under favorable conditions this saving may be large enough to pay interest and other fixed charges upon the additional construction investment and still have a satisfactory margin to apply on dividends. Under general conditions, however, it is altogether improbable that the direct saving resulting from the simple substitution of electric for steam power will be sufficient to justify the additional investment and financial risk.

In changing the method of motive power on existing railways, the conditions are by no means so simple as in the construction of new lines, as in the former case a great amount of capital already invested must be sacrificed, and the problems of adaptation to existing conditions are peculiarly severe. In particular, the transition stage in bridging over the gap between steam and electric operation is both expensive and difficult, as the change affects train lighting and heating, telegraph and telephone service, signaling, and track maintenance, for which both temporary and permanent provision must be made. The simultaneous maintenance of facilities and working forces for both steam and electric service within the same limits will be rarely profitable, for the reason that a large proportion of expenses incident to both kinds of service is retained, without realizing the full economy of either.

To secure the fullest economy it is necessary to extend the new service over at least the whole length of the existing engine stage or district, and to include both passenger and freight trains, and in this connection it is interesting to note that in the case of the New Haven company the passenger train mileage forms so large a proportion of the whole that no additional generating and transmission capacity will be needed when electric traction is extended to freight service.

The application of electric traction to heavy railway service will probably be governed by other and more important considerations than its mere relative cost as a motive power under similar conditions, as illustrated in the development of the ordinary trolley service. In this development the commercial value of higher speeds and of increased car capacity is so large that the relative cost of electric versus animal tractive power becomes almost negligible by comparison. Analogous results may be hoped for in the corresponding development of electric traction in heavy railway service, as the new conditions will afford opportunities for at least two radical modifications of existing conditions, quite apart from minor economies.

In steam service the weight and speed of trains are limited by the horse-power of the locomotive, which generates its own power, and there are only a few locomotives which can generate sufficient steam to utilize their full cylinder tractive force at speeds in excess of 12 miles an hour. Consequently, any increase of speed beyond certain limits can be attained only by sacrificing train tonnage in a corresponding degree. The division of the train-mile cost by the lesser number of tons increases the ton-mile proportionately. The high cost of fast freight service is principally due to the effect of this diminishing divisor, while it would seem that electric traction should permit high speeds without sacrificing commercial tonnage, because, with a relatively unlimited source of power at command, the maximum drawbar pull permitted by the motor design, may be maintained at all speeds. The commercial value of high speed in freight and passenger service is so great that the prospect of escaping the present penalties accompanying reduced train capacity becomes doubly interesting.

Hardly less important is the opportunity afforded at the opposite end of the scale, for the economical operation of trains of minimum load. The train load cannot be reduced without loss, below the point where the earnings equal the train-mile cost, and if this cost cannot be reduced proportionately with

reduced load, the inferior limit of load may be uneconomically large. In steam service the irreducible elements entering into the train-mile cost are so large that it is rarely profitable to operate trains earning less than 40 to 50 cents per mile. In contrast, electric service permits an extreme reduction of the train length to single car units, costing to operate from 10 to 15 cents per car-mile. Hence, the frequency of service may be increased and the rates reduced, which in turn will react upon the volume of traffic, with the final result of increasing both the gross and the net earnings. It may, therefore, be claimed for electric traction that it will extend the limits of profitable operation of high-speed heavy trains, and also of light trains.

Other, but relatively minor advantages are possible in the effect upon earnings, due to the elimination of smoke, gases, dust, cinders and heat, the better ventilation of cars, the extension of electric train lighting and heating; and of the effect upon expenses due to the concentration of power production in large and economical power houses, a reduction of engine repairs, an increase of effective engine and train mileage, a more or less complete elimination of engine houses, turntables, fuel stations, water tanks, cinder pits and other operating facilities, the consolidation of power requirements for traction, pumping, operating shops, elevators and general uses, and the use of electricity for lighting switch lamps, stations and other buildings.

Finally, the availability and value of real estate and structures at large terminals will be greatly augmented by the possibilities of using two or more superimposed track levels, as strikingly exemplified in the plans for new terminals in New York City for the New York Central and the Pennsylvania companies.

A general change from steam to electricity will render unproductive a very large amount of invested capital, and create the necessity for the expenditure of additional amounts still greater, but there is no reason to doubt that the transition already in progress will be rapidly extended and applied at all points where congested terminals, high frequency of train service and low cost of energy create favorable conditions.

Ohio Telephone Independents.

The Ohio Independent Telephone Association met at Columbus on Aug. 6, when some 350 persons were in attendance, at the Southern Hotel. The presiding officer was Frank L. Beam, of Mt. Vernon, formerly general manager of the Columbus Citizens' Telephone Company.

There were several addresses on the programme preceding the report of the resolutions committee. Harry M. Daugherty, general counsel for the Columbus Citizens' Company, spoke on "Why Is Independent Telephony so Successful?" W. G. Thompson, of Hamilton; James B. Hoge, of Cleveland, and H. B. Folsom, of Circleville, discussed "Why Is Competition Desirable in the Telephone Business?" and A. Hess, of Sidney, told of the enforcement of the general laws of Ohio in reference to the telephone business.

After the addresses this resolution was adopted unanimously: "Whereas, It is the sense of the independent telephone companies of Ohio, composing this association, that its members refuse to enter into any contracts or arrangements whereby competition is eliminated and that all violation of law arising from such arrangements or contracts will be prosecuted by this association,

"Resolved, That the executive committee is hereby authorized to take such steps as are necessary to carry this resolution into full effect."

This resolution is understood to mean that the association will invoke the Valentine anti-trust law against any company which enters into a contract with the Bell company for the retirement of the latter from the local field in exchange for the long distance business of the independent company.

After luncheon the subject of the advances being made by the Bell companies to the independents was again taken up and, after a long discussion, the following resolution was unanimously adopted:

"Whereas, Certain independent telephone companies have violated their contracts with the United States Telephone Company by permitting unauthorized connections and interchange of business prohibited thereby, to the serious injury of every independent telephone company in Ohio, or interchanging business business therewith,

"And, Whereas, The maintenance of competition in long distance telephone business is deemed necessary for the best interests of the companies as well as the public,

"Therefore, Be it resolved by the Ohio Independent Telephone Association in convention assembled that we deem it the duty of the United States Telephone Company to enforce its contracts wherever violated, and, be it further resolved, that we demand that the United States Telephone Company bring suits, if necessary, against all companies violating their contracts with it and this association pledge its unqualified support to said company in the prosecution of such actions."

It is said the independent long distance company will bring suits for violation of contracts against several independent companies.

New York Destructor Plant for Lighting a Failure.

New York's refuse-burning plant as a means of lighting the Williamsburg Bridge across the East River has been abandoned and the Department of Water Supply, Gas and Electricity has called upon the New York Edison Company to illuminate the structure and to supply whatever additional electricity may be required. It will be remembered that this plant was described in the Electrical World of Nov. 18, 1905. The destructor station is at Tompkins and Delancey Streets, just beside the bridge, and was used by the Street Cleaning Department for destroying a portion of the city's rubbish, which heretofore was taken out to sea and dumped. The fuel was supplemented with coal at times for feeding boilers supplying steam to two 100-kw and one 50-kw electric generating units, the energy from which was used to supply the Williamsburg Bridge. It was estimated at the time that the plant would save the city about $10,000 yearly.

The generators supplied 180 arc lamps, 767 incandescent lamps, three electric motors and 20 electric heaters. The following data on the plant for the year 1906 during which time it may be said to have been operating under its best conditions, having passed the experimental stage, will doubtless be of interest:

Cost of incinerator, buildings, equipment and boilers	$62,092.28
Cost of generating plant, wires, lamps, etc.	60,255.34
Cost of operating incinerator, including repairs, supplies, coal and interest at 4 per cent.	45,022.29
Cost of operating electric plant, including depreciation at 5 per cent and interest at 4 per cent.	31,418.28
Actual saving to the Street Cleaning Department as compared to the cost of final disposition.	8,052.67
Actual cost to the Street Cleaning Department to effect the above saving	36,969.62
Estimated cost of running the lighting plant with coal as fuel.	57,232.00

It will be noted from the above figures that no charge is made for depreciation on the incineration plant, nor are any charges made for administration, taxes, etc. We regret that we are unable to obtain the total kilowatt-hours of energy generated so as to give the cost of energy per kw-hour, as compared with the cost if supplied by a central station. The city's engineers, however, have been frank enough to admit that the plant was being operated at a loss and was unsatisfactory at all times as a lighting plant for reasons given below.

The incinerator has disposed of 39,647 loads of rubbish a year. Each load consisted of approximately 7½ yards of material; but this was reduced by picking and compressing to about 2½ yards at the furnace. A large part of the difficulty encountered in the work of keeping up steam in the boilers was the accumulation of slag, which choked the flues and ran back on the grates. This slag was caused by glass, sand, etc., in the rub-

bish which escaped the pickers. Besides this, the quality of the fuel caused great variations in the heat obtainable, and the necessity of opening the large feed holes for putting large articles, such as sofas, barrels, boxes, etc., into the fire, caused contractions which ruined the incinerators. These are now practically fit for junk; but the electrical equipment is in first-class condition and does not represent a total loss. The building also may be utilized for some other purpose or may be still retained by the Street Cleaning Department.

Another condition which was inimical to economical operation was the necessary rehandling of the rubbish. This came in during the day, and the lighting plant was run at night, so that in the meantime the rubbish had to be stored. In addition, the heavy lighting load came during the winter months and the quantity of rubbish gathered in winter is not near so much as is gathered in summer. The plant, moreover, was being operated by the Street Cleaning Department, while the benefits were derived by the Bridge Department. When the Street Cleaning Commissioner, in an endeavor to cut down expenses, abandoned the plant, matters were brought to a head, and inasmuch as the bridge had to be lighted and the Bridge Department had no appropriation for that purpose, it fell to the lot of the Department of Water Supply, Gas and Electricity to supply the electricity with the result that a contract was made with the New York Edison Company at the company's regular rates.

The Department of Street Cleaning claims that the plant was built by a former commissioner as an experiment and was never expected to furnish enough steam to run the generating equipment to light the bridge. If it had been successful, however, and there had been no change of commissioners, a larger furnace installation would have been made so as to furnish sufficient steam to run the generating equipment. The Street Cleaning Department could supply more rubbish than necessary, the plant only using about one-eighth of the rubbish gathered, and it would be folly to burn this unless some use were made of the heat. The experiment of lighting the bridge was the only means of utilizing this heat, and after a two-year trial the experiment was found to be a failure.

Central Station Improvements at Houghton, Mich.

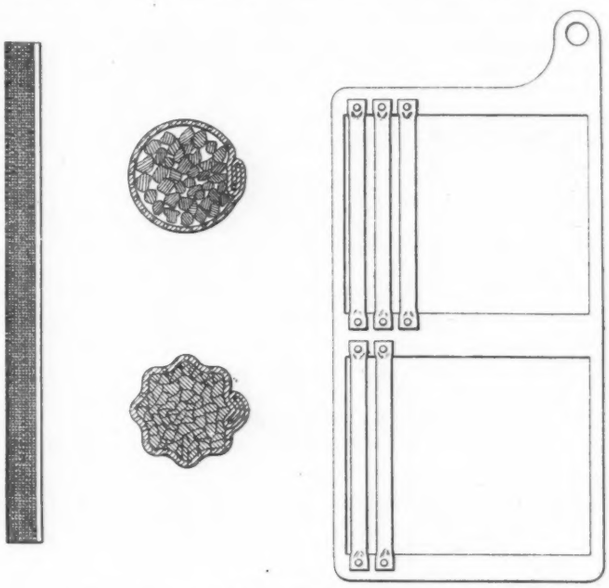
A number of important improvements have recently been made in the central station system of the Houghton County Electric Light Company, under the direction of the Stone and Webster Engineering Corporation. At the switchboard in the Houghton station the lighting circuits were formerly connected directly to one set of the main bus-bars through air-brake switches, and were protected by fuses and circuit breakers. As the loads on the circuits became too heavy for this method of control of a 2300-volt system the old switches were replaced by General Electric hand operated oil switches. In the new arrangement the lighting lines are fed from an auxiliary set of two-phase busses which may be thrown upon either set of main bus-bars through a four-pole double-throw oil switch, with automatic overload release.

Provisions have been made for running additional circuits by building a wire rack into the wall at the west end of the switchboard gallery, allowing for two new high-tension lines and seven 2300-volt, single-phase circuits. This outlet is primarily intended for the Atlantic mine. General Electric type V line drop compensators have been placed in some of the 2300-volt suburban lighting circuits. The company has always found it preferable to feed from alleys rather than streets. Outlying distribution circuits are also being extended in length and capacity.

Special power rates are now in force for day service. The minimum charge per month being 50 cents per hp of connected load. The rates depend on meter readings and vary from 7 cents to 1.85 cents, the latter rate being given on excess consumption of 100,000 kw-hours per month. Customers on these rates are allowed to use power at any time during the day except between 5 and 11 p. m. during November, December, January and February and except from 7 p. m. to 11 p. m. the remainder of the year. Customers who wish to use power 24 hours per day are charged $1.50 per hp per month in addition to the meter charge.

Edison Storage Battery Patent.

A patent issued July 6 to Thomas A. Edison relates to improvements in his form of cobalt-nickel alkaline storage battery, designed to reduce to a minimum the amount of active material in the form of flakes or films on cobalt or a cobalt-nickel alloy, and to secure a maximum degree of conducting capacity. A unit tube (Fig. 1) is formed from a thin perforated



FIGS. 1, 2, 3 AND 4.—EDISON STORAGE BATTERY.

sheet of sheet-iron or nickel, thinly coated on each side with cobalt-nickel alloy. After the seam is formed the tube is subjected to a high temperature in hydrogen to weld the seam, after which the tube is filled with active material and then corrugated longitudinally, as shown. The tubular units are then secured by rivets to grids, as shown in the illustration.

CURRENT NEWS AND NOTES.

MUNICIPAL ELECTRICIANS.—The twelfth annual convention of the International Association of Municipal Electricians was held at Norfolk, Va., last week, with a good attendance, and several papers were read. Seventy-five cities were represented. The Jamestown Exposition was one of the special attractions and entertainments.

IRON OXIDE RESISTOR FOR LIGHTNING ARRESTER.—In order to limit the amount of current which can follow a lightning discharge across the air-gap of an arrester use is generally made of a series resistor in the form of a rod containing a mixture of graphite and clay. It has been found that the conductivity of such a composition is not constant, but varies with each discharge of current. The graphite burns out, especially at the terminals of the rod, thereby increasing the resistance of the rod and finally open-circuiting the device. A patent issued to Dr. C. P. Steinmetz, on July 23, discloses a method of overcoming the difficulty by substituting oxide of iron or of chromium for the graphite. These oxides are to a certain extent conductive, yet their resistance is high. The resistor rod is made fairly homogeneous by the use of a binder of potassium silicate or sodium silicate.

O. E. L. A.—The Ohio Electric Light Association will hold its thirteenth annual convention at Toledo, Ohio, on Aug. 20, 21 and 22 at the Boody House, when, as noted, a very interesting set of papers will be discussed. An unusually large attendance is expected, and a sumptuous special souvenir programme, large oblong quarto, bound in soft green leather and silk, has been issued to signalize the occasion. In addition to the regular business sessions, there will be a number of entertainment features.

TECHNICAL TRADE LITERATURE.—The Technology Department of the Carnegie Library of Pittsburg is making an extensive collection of trade catalogues, and will be glad to receive catalogues of any of the advertisers in The Electrical World. These catalogues will be given a prominent place on the shelves, carefully catalogued under both firm name and subject, and made accessible to the public. Catalogues should be addressed care of H. W. Craver, Technology Department. Carnegie Library, Pittsburg.

TELEPHONY IN ATLANTA.—Now that telephone franchises are falling in or being renewed, considerable interest attaches to the new terms made. The Southern Bell Telephone Company has made the announcement that it will waive all claim to a perpetual franchise in the city of Atlanta. The statement is made by Mr. W. D. Gentry, local manager, who offers in behalf of the company to pay ½ per cent of the gross receipts for 10 years and 1 per cent for 23 years, in addition to the regular ad valorem taxes, if the city will grant the company a 33-year franchise. The ad valorem taxes for 1908 will amount to about $9,000. The proposition is being considered by a special committee of the City Council.

HANDLING GLASS MAGNETICALLY.—An interesting variation in "lifting magnet" practice is shown in a patent recently issued to Mr. Ethan I. Dodds, of Pullman, Ill., for handling glass in sheet or crates, etc. Beneath the glass or other material, he places a sheet or pieces of magnetic material, and above the glass he operates electromagnets, manipulated and controlled by a crane, derrick, hoist or the like. The pull on the metal beneath the glass constituting the armature or armatures by the magnets causes the armature to support the glass, thereby permitting it to be transported by the crane. Mr. Dodds naturally uses a plurality of adjustable magnets for this purpose and, by rendering the magnetism sufficiently strong boxes or crates of glass or similar non-magnetic material can be conveyed safely and expeditiously from one place to another so long as the magnets are energized.

TELEGRAPH STRIKE.—The smoldering fire of discontent among the telegraph operators broke out in full blaze again this week, and several thousand operators went on strike all over the country, from both the Western Union and the Postal systems. This was apparently quite unexpected when the move was made last Sunday and Monday, and was contrary to the wishes of the union officials and to an agreement to wait until Friday, by which time it was hoped peace might be secured by intervention. Some of the Associated Press operators also went ont in sympathy. Both the great companies deny that they are crippled, although their forces are seriously lessened, and business is being carried on at all the large centers. One effect has been to increase telephone patronage, particularly the long-distance service. So far the striking telegraphers have been well behaved, but the offices are guarded by police.

WIRELESS DETECTORS.—A recent patent issued to Mr. H. H. C. Dunwoody, of Washington, D. C., deals with wireless telegraphy wave responsive to detecting devices. He claims to have found that what is ordinarily known as the "loadstone" is well adapted to the purpose, as well as the artificially produced material of crystalline form, whether the triferro tetra oxide commonly called the magnetic oxide Fe_3O_4, or the sesqui oxide, having the general formula Fe_2O_3, preferably the former, his tests showing it to be the more sensitive. This material may be of any desired shape or size, and is generally used in the form of a concrete mass or body of crystals which may vary in size and character. This wave responsive material can be connected in the circuit of a single receiving apparatus in many and various ways. One drawing shows a vessel with some such electrolyte as mercury, or an acid, or an alkali, and with the detector devices in the shape of a conical or pointed mass dipping its tip into the surface.

ELECTROLYTIC CONDENSER.—A form of electrolytic condenser has been patented in this country by Mr. Ignacy Moscicki, of Fribourg, Switzerland, the novelty of which is that one of its electrolytic coatings is contained in the interior of a tubular dielectric, which is itself sunk in the other coating. In one form which is illustrated, a vessel made of insulating material contains a fluid electrolytic conductor such as sulphuric acid, potash lye, soda lye, etc. Into this the electrolytic conductor which forms one coating of the condenser, a narrow tube, closed at one end and made, for example, of glass, is dipped, the top of the tube passing through a junction of the vessel and the interior, containing a fluid electrolytic conductor as an inner coating. This tube which acts as a dielectric is wound in spiral form so that while of considerable length it occupies exceedingly little space. A conducting wire made of lead runs through the whole interior length of the tube and projects from the top. On the bottom of the vessel is an electrode plate made of lead and connected with a conducting wire that runs through a junction of the vessel. The two conducting wires serve for connecting the two coatings with an external circuit. Owing to the conducting wire running through the whole length of the tube the resistance in this tube is greatly diminished. Another form is so modified as to give two such condensers arranged in series in the one vessel.

INTERRUPTER AND RECTIFIER.—Mr. Harold A. Yarnell, of Los Angeles, Cal., has assigned to the Pacific Wireless Telegraph Company of that city an interrupter and rectifier, capable also of serving to interrupt the circuit through the induction coil of the transmitter in wireless telegraph systems, or of use in X-ray work. A general idea may be formed from the first claim: "An electrical interrupter and rectifier comprising a liquid, a shell with a perforated end immersed in the liquid, an electrode in the shell with its end projecting through the perforation in the shell, a tube outside of the shell, the lower end of the tube having arms which support a cone upon which cone the lower end of the electrode rests, and means for securing vertical relative adjustment between the tube and shell whereby the effective contact area of the lower end of the electrode may be regulated." In using this form of apparatus in the transmitting station of wireless telegraph systems, Mr. Yarnell has connected with one terminal of a circuit using alternating current and with one pole of the primary of the induction coil; the other pole of the primary was connected to the other terminal of the supply circuit. Upon closing the circuit through the apparatus, the current passes through the terminal and through the electrolyte and through the electrode and primary of the induction coil. The effective contact of the electrolyte with the electrode is limited by the orifice, and upon the passage of the current, the liquid is forced away from the lower end of the electrode forming a bubble so to speak, which automatically breaks the circuit, which, however, is immediately closed by reason of the destruction of the bubble, the liquid renewing itself in contact with the electrode. This action takes place in quick succession whenever the circuit through the device is closed, even if closed only for an instant. This automatic interruption occurs also when a direct current is used. In addition to this automatic interruption of the current. the device, when used with an alternating current acts also as a rectifier, thus making it possible to employ the device for converting an alternating current into a direct current.

BUENOS AIRES TRACTION.—The city authorities of Buenos Aires, Argentine Republic, are advertising for short term tenders for the construction of underground contact street railway lines.

ELECTRICITY IN MANILA.—The Jesuit Fathers, it is stated in a recent Government bulletin, have just established an electrical laboratory at Manila, P. I., and will teach electrical science and engineering. The course is said to be laid out for five years.

OLD TIME TELEGRAPHERS.—The twenty-seventh annual reunion of the Old Time Telegraphers' and Historical Association and the Society of the United States Military Telegraph Corps will be held at Niagara Falls, N. Y., Sept. 16, 17 and 18. Headquarters will be at the Cataract and International Hotel. Mr. John Brant, 195 Broadway, New York, is secretary of the Old Timers' Association.

LIGHTNING FATALITIES.—An average of 800 people are killed in the United States each year by lightning, according to data collected by the U. S. Weather Bureau. This means that about 1 in each 100,000 of population is killed in that manner. The region of greatest danger extends from southern Vermont to Kentucky. Four times more persons of outdoor occupations are struck than those indoors. One out of every three struck survives.

RECESSION AT NIAGARA.—At the recent Leicester meeting of the British Association for the Advancement of Science, an interesting paper was read by Prof. Spencer, of the United States. Three-quarters of a century ago the English geologist Lyell computed that Niagara had taken over 30,000 years to cut its rocky precipice to its present position. Prof. Spencer many years ago came to the conclusion independently that Niagara had taken at least 32,000 years to produce this result, and now, with still more minute investigation and measurements, he calculates the period at 39,000 years.

NEWS WHILE YACHTING.—During the recent cruise of the New York Yacht Club, the *New York Herald* did a clever piece of work in supplying the fleet with news of the stock market, etc., by means of the wireless telegraph. The success of the attempt was so great that Mr. E. C. Benedict, owner of the yacht "Oneida," with large financial interests, expressed his belief that the Club would never again take its annual cruise without this service. The messages were received by wireless on the newspaper boat and then communicated to the fleet by regular flag signals. In our issue last week, the converse of this idea was given in the article on reporting yacht races by wireless telephony at Put-in-Bay, Lake Erie.

GEORGIA WATER POWERS.—It is stated from Atlanta, that strong opposition to the so-called water power bill has developed in the Georgia legislature. This bill proposes to confer upon water power companies, the right of condemnation of property needed in power developments, similar to the privilege enjoyed by railway corporations. The advocates of the bill, on the other hand, claim that it will result in vast development of the water powers in Georgia, hitherto retarded by obstinate land owners. Millions of dollars, it is predicted, will pour into the state for this purpose as soon as the bill becomes a law. It is said the bill had its inception with capitalists interested in water power developments at Talullah Falls, representing Eastern and European capital.

SAN FRANCISCO TROUBLES.—Advices from San Francisco of Aug. 10 say: "The telephone operators' strike, which has caused great inconvenience for three months, was called off this week. The girls gained little by their long idleness. Their chief demands were increased pay and recognition of the union, neither of which was granted. Some minor concessions were made in regard to hours, but the girls virtually lost the strike as well as three months' wages. The telephone operators were encouraged to continue the fight for weeks after it was plain they had lost by labor union leaders, who forced other unions to contribute to the support of the girls. These same labor leaders are responsible for the continuance of the street car strikes, which would collapse in a single day were it not for the support of the labor unions. President Calhoun, of the United Railways has demonstrated that he can run his cars with non-union men. He has almost completely restored service as it was before the strike on May 1. But the labor unions assess their members to support idle street-car men and the president of the carmen's union runs a line of omnibuses in which union men are forced to ride. Nearly all the unions have fixed heavy penalties for riding on the street cars, and the result is that workingmen must spend an hour or an hour and a half in going to and from work when they could reach their homes in half an hour by the cars. No attacks are made on cars in the city, but in the suburbs every Sunday or holiday witnesses assaults on motormen and conductors and damage to cars."

THE RHINE FALLS.—With regard to the protection of the Rhine Falls from power plants, a further dispatch from Schaffhausen says: "The romantic Rhine Falls near this city have been rescued by the local council from industrial exploiters, by whom they were threatened. The councilors have refused to permit the erection of new water power works for the supply of electricity to the surrounding district. The reply to the application of the exploitation company was decisive. 'The council is of opinion that not only should the falls not be further enchained, but an effort should be made to prevent an extension of the concession already granted at its expiration in 1928. The destruction of the present works,' continues the official documents, 'would restore the original imposing magnificence of the falls and the water power now obtained from them could easily be procured at some other point. The council, though aware that this is not immediately realizable, is resolved to do everything in its power to prevent any further damage to the beauty and romantic effect of the falls.'"

ELECTRIFICATION OF SPANISH TRUNK LINE.—Electricity is to be introduced as motive power on a first trial stretch of the main line from Linares to Almeria in Spain, about 145 miles in length. The line has a practically uniform grade of 2¾ per cent, which made it more and more difficult to handle the increase in traffic with steam locomotives. This is particularly true with reference to the comparatively heavy ore trains passing over the line. The electrification will be carried out with the use of the three-phase alternating-current system. A steam central station will be installed at Santa-Fé and the electric energy will be transmitted from there at a pressure of 5500 volts direct through a double overhead contact line, thus entirely eliminating any separate transmission lines and substations. The three-phase alternating-current locomotives will be designed with a normal capacity of 320 horse-power each and for the regular train service two of these units will generally be coupled together by multiple unit control, while the lighter trains may be hauled by one single unit. The schedule calls for trains weighing from 150 to 300 tons running at a schedule speed of 16 miles per hour both up and down grade. The normal time table is arranged so that one train will start from each terminal every hour. Full advantage is to be taken of the feature, unique with the three-phase, alternating-current system, whereby energy is returned to the line by the trains going down the grade. Operation on the trial stretch is to be begun early in 1908. If the trials turn out entirely satisfactory the complete line is to be electrified at once and water powers in the neighborhood have already been secured for that purpose. We are indebted to Muralt & Company, engineers, of New York, for the above data on this interesting equipment.

METER INSPECTION.—The superintendent of lighting of St. Louis, Mo., Mr. T. B. Carter, proposes to bring electric meters within the present system of meter inspection which applies only to gas meters.

WIRELESS IN JAVA.—The Dutch Indian Government has granted to a syndicate a concession for establishing a wireless-telegraphy system between Java, Celebes, Borneo and the neighboring islands. The company, with a capital of 2,650,000 florins (florin = 40.2 cents American), is now in the course of organization, but there will be no public issue of stock.

GORKY ON CONEY.—Maxim Gorky in a recent description of Coney Island speaks of its electrical illumination as follows: "Thousands of ruddy sparks glimmer in the darkness, limning in fine, sensitive outline on the black background of the sky, shapely towers of miraculous castles, palaces and temples. Golden gossamer threads tremble in the air * * * Fabulous and beyond conceiving, ineffably beautiful, is this fiery scintillation."

THE TROLHATTAN FALLS.—That further utilization of the famous Trolhattan Falls is intended at an early date is shown by the fact that tenders are invited until Oct. 1, by the Swedish Government for three 350-kw direct-current generators; 1 accumulator battery of 4800 ampere-hours' capacity: 4 three-phase generators, each of a maximum of 11,000 kilovolt-amperes; 12 transformers, each of a maximum of 3670 kilovolt-amperes; cables, switchboard, etc. The execution of the work is in the hands of the Managing Director, Royal Trollhattan Canal and Waterworks, Trollhattan, Sweden.

USE OF LAMPS.—The August issue of the *Edison Light*, of Boston, says: "In a recent issue of a periodical issued by the Sterling Company, it was stated that Uncle Sam is the largest user of incandescent electric lamps in the country, requiring the enormous number of 850,000 a year. To supply its customers in Boston and the surrounding towns, the purchases of the Edison Company for this year will be between 1,200,000 and 1,300,000. The number used in such cities as New York and Chicago is probably larger. With these figures to serve as indications, some conception of the vast size of the electrical industry may be formed, and of the number of people it supplies with work directly or indirectly." The bulletin is publishing in color a series of front cover illustrations of electrical worthies at their work. The August issue shows Dr. Gilbert. That for July had Faraday. The original paintings are being done by the Hungarian artist, Havelka.

MILWAUKEE MUNICIPAL PLANT.—It is announced from Milwaukee that legal papers have been prepared in a suit to enjoin the city from erecting a proposed $1,000,000 electric light plant, to compete with the present private corporation, the Milwaukee Electric Railway & Light Company, the grounds for the injunction are that the city needs to invest $1,500,000 in bridges, viaducts, schools, and other necessary improvements. To erect the city light plant as proposed will mean an indefinite deferring of the other improvements, as the city is now too near its bond limit to build both the light plant and the improvements. The injunction is supported by all three of the city business men's associations. When the Socialists began their agitation for a municipal light plant there was considerable public sentiment in favor, but that has disappeared. The city controller has announced that owing to the city's financial condition he will not countersign contracts for the plant. The Socialist element, however, holds the balance of power in the city council, and the granting of the injunction will mean a bitter fight.

TELEPHONY IN CONNECTICUT.—An illuminating comment on the telephone situation, and on public service corporations in Connecticut, is made by a special correspondent of the New York *Evening Post* as follows: "During most of the legislative session an acute conflict has been waged over the telephone question. For nearly a quarter of a century the Southern New England Telephone Company has had a monopoly of the state, except in the town of Greenwich, which belongs to the New York system. The corporation paid good dividends early; then was forced to suspend them for years during neglected renewals and improvements; and has since paid 6 per cent dividends, with occasional minor 'melons' in stock issued at par or slightly above. On the whole it has been a benign monopoly, with pretty good service, rapid extensions, reductions of rates, and stock, originally watered, solidified by betterment of plant and 'ploughing in' surplus earnings. It has been protected behind the so-called 'Parallel Telephone act' of the state, that requires new telephone enterprise to go to the courts on the question of public necessity and convenience, and also to obtain from the Legislature a special charter. Its contest with rivals, supported by the state granges, seeking to enter the Connecticut field, was sharp and continuous during most of the session. A good deal of money was spent by both sides in the lobby, and the judiciary committee, which had charge of the telephone bills, backed and filled many times. The outcome was an ostensible compromise that allows new telephone companies to organize under a general act, but compels them still to appeal to the courts on the point of local convenience and necessity. This presumptively leaves the existing company in possession of the field for another two years at least. The result must also be regarded as favorable to the company, and of general significance, as, by implication, the state recognizes the theory of 'national monopoly' in a public service corporation."

HYDRAULIC MINING.—There is an interesting discussion of hydraulic mining in *Mines and Minerals* for August, which mentions one electrical improvement. The power of the water issuing from a monitor is enormous and many men have been killed by monitors getting away from them. Improvements, however, have been made in handling them so as to render them comparatively safe. The effect of a monitor running away can be appreciated from the experience of firemen, where, with comparatively small hose and under small head, considerable damage may be done. If a 2-in. nozzle does this damage, the effect of an 8-in. or 10-in. nozzle and with water under a much higher head, can readily be appreciated. The method of control in turning the monitor easily in any desired direction, is said to have been discovered in a peculiar way. A man wanted to clean his shovel, so he placed it alongside the water column as it issued from the monitor and was surprised to see the monitor suddenly move. The foreman who had been watching the operation then rigged up a contrivance which has been subsequently called a deflector, which is a ring around the nozzle and which can be readily moved to allow the current of water to be projected against it. The pressure from the little finger on the deflector is sufficient to turn the monitor around as the latter works in a ball-and-socket joint. The introduction of the deflector has undoubtedly saved many lives and greatly facilitated operations. What promises to be one of the greatest improvements which has been made in hydraulic mining in the past few years is a device for operating and turning the monitor from a distance. The nearer the monitor can be placed to the bank the more effective will be the impact of the stream. The great danger of operation has been that where the bank is high, there is apt to be a fall of rock and dirt upon the men handling the monitor. "An attempt to solve this has been made by the manager of the LaGrange Mine, in California, by the use of magnets to move the deflector, controlled by means of electric wires leading to the magnets of the monitor, thus enabling the latter to be placed very close to the bank and operated from a distance, greatly increasing its efficiency without endangering the lives of the operators. This has been tried only on a small scale as yet but it is thought it can be made practical for large monitors."

Kern River No. 1 Power Plant of the Edison Electric Company, Los Angeles—II.

STEEL-CONCRETE FLUME.

THE flume between tunnels No. 6 and No. 7 across Laird Canyon is constructed of structural steel and concrete, as shown in Fig. 10. The whole structure is carried on 15-in. steel I-beams set 8 ft. 10 ins. apart and supported by concrete piers. These longitudinal girders carry 9-in. steel I-cross beams set 4 ft. from center to center, and on them is erected a framework of structural steel for the sides and bottom of the flume. The layers of expanded metal (1½ in. and 3 ins. mesh), are used in connection with this framework and, filled with concrete, form the plates enclosing the frame. This concrete construction is also reinforced on the floor by twisted ½-in. rods. The outside and inside of the flume were then plastered, making the thickness of the reinforced concrete sides and bottom 4 ins.

This type of flume or conduit had never been tried before, but in this case it has proved a decided success, and while it costs more than a wooden flume, it has the advantage of being as permanent as the tunnels themselves.

CONCRETE CONDUITS.

In the lengths of tunnels and flumes forming the gravity conduit enumerated for Kern River No. 1 power plant no account is taken of the concrete conduits which connect some of the tunnels and which also connect the tunnels with the flumes. There were places along the line where the tunnel emerged at the foot of a steep incline in such a manner that the flume if constructed on the grade would be threatened by landslides or boulders rolling down the side of the mountain. These places were spanned by means of concrete conduits, the interior of which has the same cross-section and slope as the tunnels themselves. The walls are made heavy and reinforced with steel and an arch overhead, the arch being covered with a cushion of earthen material to receive the impact of anything rolling or sliding down the hill, and passing over the conduit. There are eight of these conduits, the following table giving the length of each:

CONCRETE CONDUITS, KERN RIVER NO. 1.

No. of Conduit.	Length in Feet.
1	100.00
2	69.4
3	6.2
4	42.2
5	40.0
6	92.5
7	31.6
8	121.6

FOREBAY.

A terminal equalizing reservoir of some size at the end of the gravity conduit and feeding the pressure main would have been desirable in connection with the Kern River No. 1 project. However, the side of Mr. Breckenridge, where the lower end of Tunnel No. 19 emerges above the power house, is approximately on a 45 deg. slope, making it impossible to excavate any large area for a terminal reservoir or forebay. It was necessary, however, to have a small basin for regulating the flow into the force main, and for this purpose a chamber 30 ft. x 42 ft. was excavated to a depth of about 8 ft. below the grade of the supply tunnel. Inside of this and over the mouth of the force main were erected controlling gates and screens through which the water passes into the force main.

The walls of the forebay were made of concrete in the form of retaining walls, where they were enclosed in the excavation,

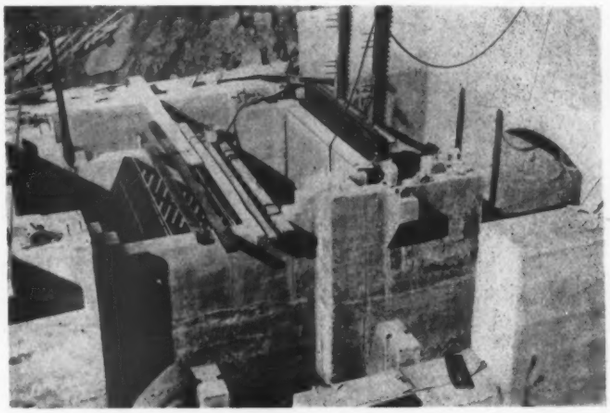


FIG. 11.—FOREBAY BEFORE COMPLETION, SHOWING PORTAL OF TUNNEL NO. 19.

and on the lower side where they were unsupported they were made sufficiently heavy to withstand the pressure of the water on the inside of the forebay. As the formation where the structure is located is somewhat shattered, the concrete work was heavily reinforced and the floor was paved with 3 ft. of concrete. In the rear these walls were extended up to a considerable height to prevent material caving from the mountain above from dropping into the forebay.

On one side is a spillway 9 ft. above the floor of the forebay, and consisting of five 82-in. openings over which the water flows into the waste flume when it is desired to divert part or all of the tunnel flow from the pressure main. The height of this spillway can be controlled by means of flash boards which may be inserted and removed as required, according to the quantity of water carried through the tunnels. The extreme height of the spillway is 3 ft. A 24-in. gate valve is set at each end of the spillway for sluicing into the waste flume.

The force main starts from the bottom of the forebay, thus making it possible to have the water enter it from opposite

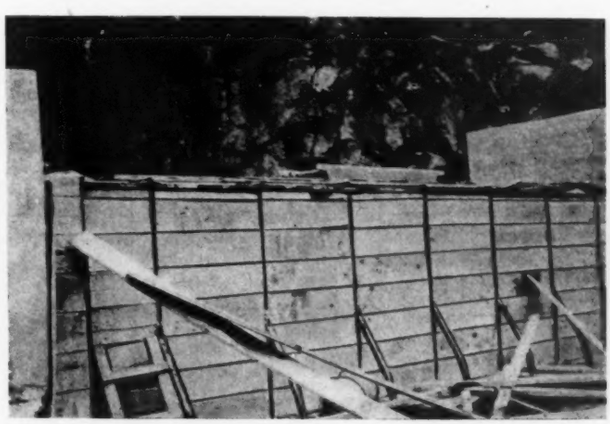


FIG. 10.—STEEL CONCRETE FLUME CONNECTING TWO TUNNELS.

FIG. 12.—FOREBAY AND UPPER END OF WOODEN WASTE FLUME.

directions. This construction tends to prevent the formation of eddies or a whirlpool at the entrance.

The controlling gates have an opening 6 ft. 2 in. high and 10 ft. wide, and are built up of 4 in. x 12 in. timbers on two vertical 6-in. steel I-beams. They are raised by means of hand-

operated gearing through four sets of gears working into two racks (7 in. wide and 3 in. pitch) mounted on the front of each gate. Behind the gates and inclined upward toward each other are two heavy grizzlies. These are formed of 3½ in. x ½ in. iron straps, spaced 3 in. centers by thimbles of 2½-in. wrought-iron pipe, the rows of thimbles being set 1 ft. apart. Each screen is 11 ft. 6 in. long and is set on an angle with its top supported by a 4-in. steel I-beam. These two beams are set 3½ ft. apart, the space between forming a walk.

WASTE FLUME.

The forebay is constructed so that when the water is diverted from the force main, it passes over the spillway automatically into the waste conduit extending down the mountain side to the river. This conduit is of concrete at the upper end where it is on comparatively flat grade, the section being 8 ft. wide and 8 ft. 6 in. high. The water is discharged into a redwood flume 20 ft. wide, that carries it down the steep slope of the hill. As the slope is about 45 deg. no material except soft wood would stand the wear due to the high velocity. The spillway flume is 1200 ft. long and it discharges into the Kern River about 600 ft. above the power station.

The flume rests on 4 in. x 6 in. stringers bolted to 3 in. x 3 in. x ⅜ in. anchor plates imbedded in concrete footings. These footings are spaced 8 ft. apart and are securely set, although they are not carried down to bed rock in all cases. The cross beams of the flume are 4 in. x 6 in. timbers, 26 ft. 6 in. long. The side posts are 4 ins. square and are carried up 3 ft. 3 ins., being secured at the bottom by angle plates. They are set 4 ft. center to center, and are angle-braced by 4 in. x 4 in. pieces fastened at both ends by ½-in. bolts. For lining the flume 2 in. x 12 in. redwood planks were used, the joints in the floor being caulked and covered with 1 in. x 6 in. battens. Quarter rounds were nailed in the corners as in the other flumes. The side lining, which is carried up 3 ft. high, is battened and caulked in the same manner as already described for the smaller flumes.

PRESSURE MAIN.

The greatest innovation in the entire Kern River No. 1 plant is the pressure main, the construction of which has been along new lines and in decided contradistinction to the custom-

FIG. 13.—WASTE FLUME DISCHARGING WATER FROM FOREBAY INTO KERN RIVER.

ary practice of laying a steel pipe on the surface of the mountain slope or merely burying it sufficiently to cover it for protection against freezing or expansion and contraction such as might be caused by a wide range of temperature changes. The pressure main constructed on Kern River consists of a tunnel approximately 1700 ft. long driven through the mountain on an incline, and lined with steel varying in thickness from 3/16 in. to 1½ in. This tunnel begins at the bottom of the forebay, passes down at an angle of approximately 45 deg., and, turning into a horizontal section, emerges at the lower end on a level with the floor of the power station. There are three vertical curves in the tunnel. The

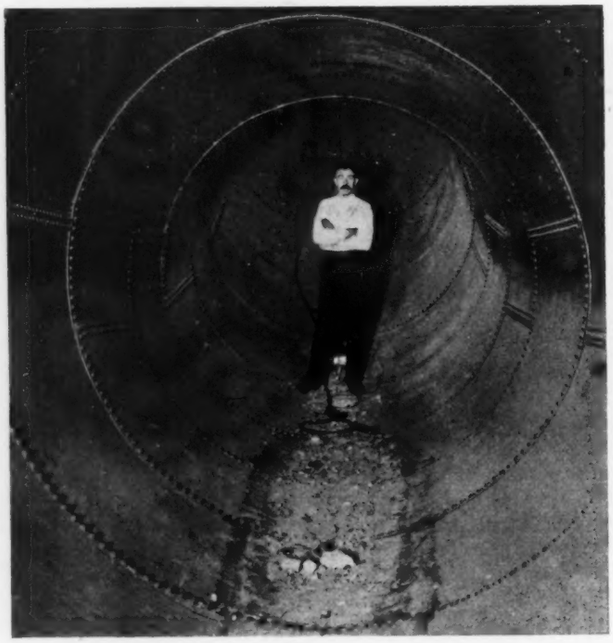


FIG. 14.—INTERIOR OF PRESSURE MAIN AT CURVE BETWEEN HORIZONTAL AND INCLINED SECTIONS.

upper one forms an angle of 7 deg., 260 ft. from the forebay floor. The second curve, 32.5 ft. lower down, has an angle of 5 deg. and turns the pipe into a grade of 84.93 per cent on which it is carried 994.24 ft. to vertical curve No. 3. This latter curve has an angle of 40 deg., and from its lower end the pipe continues along on a horizontal grade to the power house, the total length of the main being 1697 ft.

The pressure main is finished to give it an inside diameter of 7 ft. 6 in. At the top a taper 20 ft. long and 10 ft. in diameter at the forebay entrance terminates in the regular 7½-ft. diameter of the completed tunnel tube. This diameter is maintained throughout the inclined tunnel, and on the horizontal beyond vertical curve No. 3 for a distance of 167.39 ft. At this point, 1454.44 ft. from the forebay, the force main emerges from the solid rock and is carried to the portal, a distance of 243 ft. through a detrital deposit lying between the mountain and the power-house site. Where the tunnel emerges from the solid rock a 20-ft. taper was installed, reducing the diameter of the main from 7½ ft. to 5¼ ft., at which diameter the pipe is carried to the branch piping at the power house.

The inclined part of the pressure main and the portion of the horizontal section that passes through solid rock were finished by installing a steel lining built up of plates 3/16 in. thick for the incline and ⅜ in. thick for the horizontal, riveted together to form a cylindrical pipe 7½ ft. internal diameter. The tunnel itself was driven in approximately circular form, and 9 ft. in diameter. The steel pipe was centered in the tunnel, being installed in 10-ft. sections, and the space between the outside of the steel lining and the bed rock was thoroughly filled with a mixture of concrete, consisting of three parts sand, three parts crushed rock and one part Portland Cement. The work of installing this lining was begun at the lower end in the horizontal section where the pipe is tapered down to the diameter of 5.25 ft. At this point the 20-ft. taper already mentioned was placed, it consisting of 1⅜-in. steel plate riveted together with butt straps. The

taper was placed back in the solid rock and around it was constructed a heavy bulkhead of concrete which was anchored into the bed rock by means of steel rods driven into the sides.

From this point the installation of the light steel lining with concrete back fill as already stated progressed from the bottom to the top of the tunnel, terminating at the reinforced concrete taper that connects with the floor and the forebay. The rock for-

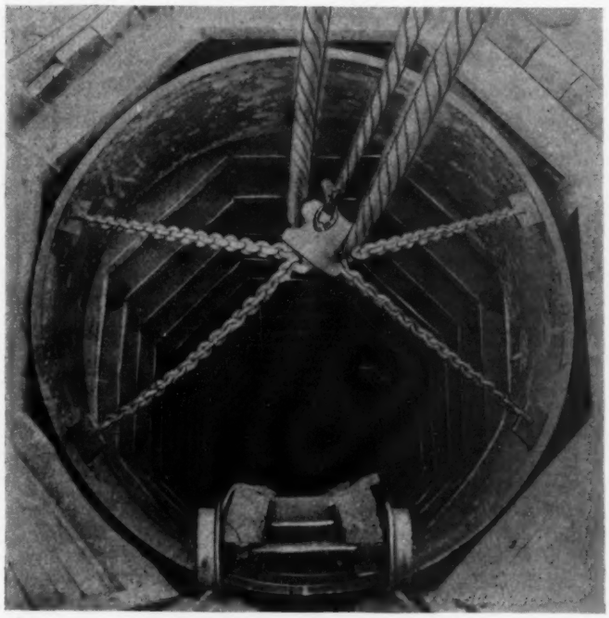


FIG. 15.—DOLLY CAR FOR LOWERING SECTION OF 90-IN. PIPE DOWN THE SHAFT.

mation through which the force main tunnel was driven is not of the best kind, being very much fractured and broken. It was necessary to timber the greater part of the shaft or incline when it was excavated, and these timbers had to be removed before the steel lining was installed. The timbers were removed ahead of the steel work, the bed rock cleaned off, and the concrete tamped into place without difficulty. At a point about 120 ft. below the top the men in charge removed some timbers without bracing the sets above. This precipitated a cave-in of the shaft ,and several men lost their lives, one man being imprisoned for two weeks, after which time he was rescued in good condition. In retimbering the caved portion, octagon steel sets of 7-in., 15-lb. I-beams were used. These sets were left in place when the concrete was put behind the steel lining. The lower end of the pressure main, from the taper reducing the diameter to 5¼ ft. in diameter, was made of 1⅜-in. steel plate, or sufficiently heavy to withstand the static pressure without any external support. No concrete was placed around this pipe, and the tunnel was merely left in its original condition with the timber sets to support the ground overhead.

At a point 215 ft. above the power house, a manhole was placed in the inclined tunnel for convenience in inspecting and for use in case any repair work is necessary. The regular 3/16-in. steel lining was replaced at this point by a section of 1½-in. pipe 30 ft. long.

The steel pipe was shipped to Camp No. 1 at the power house from San Francisco in 5-ft. lengths, five sections being nested together for shipment. The outside section was riveted complete on its two longitudinal seams, but the four inner sections were riveted on one seam only, so as to allow for the nesting. at the camp the pipe was riveted into 10-ft. lengths and hoisted by means of an aerial tram to the forebay site at the upper end of the pressure tunnel. There the sections were secured to a dolly car, and lowered by means of a hoist to the point where they were riveted together. The car consisted of a truck at each end of the pipe section, the latter being hung from two timbers that passed through the pipe and rested on the axles of the trucks, as shown in Fig. 15.

All the piping in the pressure tunnel, which is constructed of steel plates of ½-in. thickness and under, is made up with standard lap joints double-riveted on the longitudinal seams and single-riveted on round seams. All pipe on the work over ½ in. in thickness is made up of butt-strapped joints throughout, with triple riveting on each side of the longitudinal seams and double-riveting on each side of the round seams.

After the steel lining was completed, an inspection of it revealed the fact that there were several places along the bottom of the pipe where voids had been formed in the concrete backing. These voids, which were revealed by tapping, were caused mainly by the difficulty experienced in tamping the concrete thoroughly around the sections of steel lining. The steel sections were 10 ft. in length, and in a few places where large irregular rock excavation occurred at the bottom of a section with only a 9-in. space at the top for handling the tamping bars some voids were naturally formed because of the insufficient tamping.

Whenever a void occurred, a hole was drilled in the pipe and liquid cement was forced in until the hole was filled. The apparatus designed on the spot to accomplish this work was an ingenious one. A section of 3-in. steel tube 20 ins. long, was fitted at the bottom with a tap that would fit the hole drilled in the steel lining. Liquid cement was poured into the void by means of this pipe, which had a capacity of about an ordinary pail. When no more cement would run in, there was fitted in the pipe a screw with a plunger at the lower end and a crank on the outer end. By means of this device, the cement was forced into the void under pressure until it would hold no more. The pump was then removed and the hole in the lining stopped up by an ordinary flush pipe plug. There were 116 of these voids tapped and filled through the lining although only three of them were of large size. A number of the voids required only a pint of the liquid cement, the quantity used varying up to the largest, for which 10 buckets of the slush was necessary. The slush used was a liquid mixture of Portland cement and sand. The work was carried on from a dolly car fitted with beveled wheels and lowered down from the top by a steel cable. About 15 days were necessary to com-

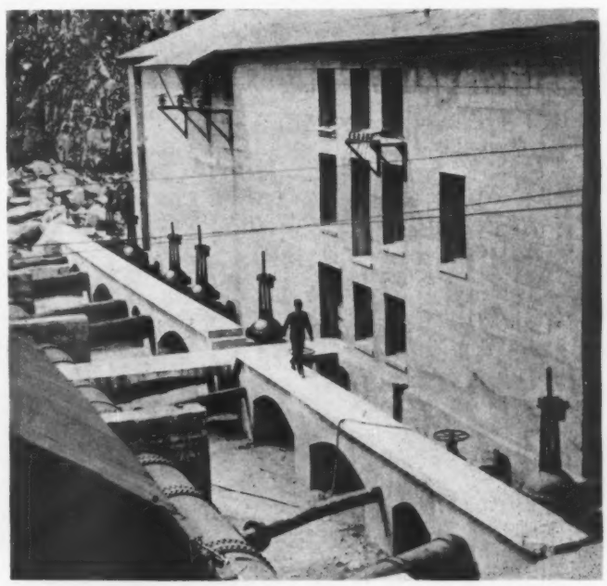


FIG. 16.—PRESSURE HEADER, BRANCH PIPING AND GATE VALVES AT POWER HOUSE.

plete this special work. After all the voids were filled the entire pipe was painted with asphaltum paint, the same dolly car being used for the purpose.

Although the design of the pressure main has been criticised by some, it is believed that the construction will stand criticism

and will prove to be permanent, and for that reason economical. The steel lining has a low factor of safety, being only heavy enough to keep its form and to resist the internal pressure, while all external pressure is taken up by the concrete back filling. which, backed up by the rock itself, also resists the internal

FIG. 17.—EXTERIOR OF POWER HOUSE.

pressures. Being entirely under ground and some distance from the surface no trouble will be experienced by reason of expansion and contraction due to temperature changes. The anchorage is the mountain itself so that no disastrous effects could result to the pressure main from any water ram that might be caused by improper handling of the water wheels or gate valves.

BRANCH PIPING.

At the lower end of the pressure main was constructed the header pipe, made of steel plates, varying in thickness from 1⅜ ins at the inner end to ¾ in. at the outer end, and consisting of the following specified lengths and diameters:

Length.	Diameter.
33.5 ft.	4¾ ft. pipe
23.0 ft.	4¼ ft. pipe
21.0 ft.	3¾ ft. pipe
11.5 ft.	3 ft. pipe
16.7 ft.	2 1/3 ft. pipe at the end

These diameters were graduated to maintain as nearly uniform velocity as possible after withdrawing the water for the various branches to supply the water wheel units in the power house. In reducing the force main at the branch pipes to meet the diameters given, the following taper pipes were employed:

1 taper	7.5 ft. diameter	to	5.25 ft. diameter,	20 ft. long
1 taper	5.25 ft. diameter	to	4.75 ft. diameter,	10 ft. long
1 taper	4.75 ft. diameter	to	4.25 ft. diameter,	10 ft. long
1 taper	4.25 ft. diameter	to	3.75 ft. diameter,	10 ft. long
1 taper	3.75 ft. diameter	to	3.00 ft. diameter,	10 ft. long
1 taper	3.00 ft. diameter	to	2.33 ft. diameter,	10 ft. long

The branches from the force main were taken off by means of a Y on the header pipe and laid out in curved form entering the power house at right angles to the rear wall. There is one branch 28 in. inside diameter, 50 ft. long, made of ¾-in. plate, for each of the eight water wheels and a 10-in. inside diameter branch pipe for each of the two exciters.

At the end of the last section of the force main is a 28-in. gate valve which discharges into the river. It is proposed to attach to this pipe an experimental nozzle for the purpose of testing nozzle tips, needle valves, etc., and it is expected that from such tests, data will be obtained regarding the flow of water under varying conditions.

In each of the branch pipes leading from the force main to the water wheels are installed two 28-in. gate valves, one outside of the power house, and the other inside. The former is intended solely for the purpose of closing off the branch pipe in case of necessary repair to the gate or piping inside of the house. These outside gates are arranged only for hand drive, while those inside the power house are equipped for operation either by hand or by electric motor, as will be mentioned later. The Risdon Iron & Locomotive Works, of San Francisco, furnished the steel lining for the pressure main, the branch piping and header and the gate valves.

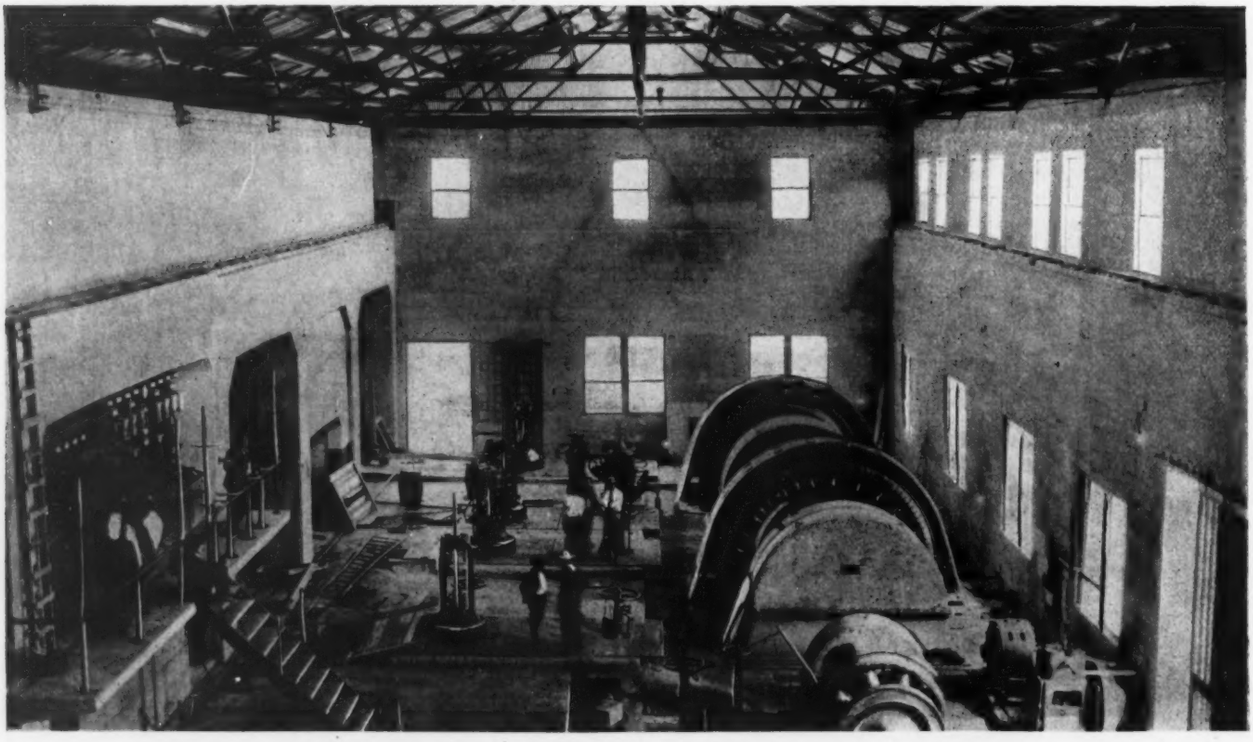


FIG. 18.—INTERIOR OF THE POWER HOUSE, BEFORE COMPLETION, LOOKING WEST.

POWER HOUSE.

The pressure tunnel emerges from the side of Mt. Breckenridge at an elevation above the sea of 1061.95 ft. Directly in front of this point and slightly up stream there was a

boulder-covered wash protected by a bend of the river and bordered by a large mass of bed-rock standing at the edge of the main channel of the river. This space was chosen as the power house site. The intake of the Power, Transit & Light Company, of Bakersfield, is directly across the stream, and

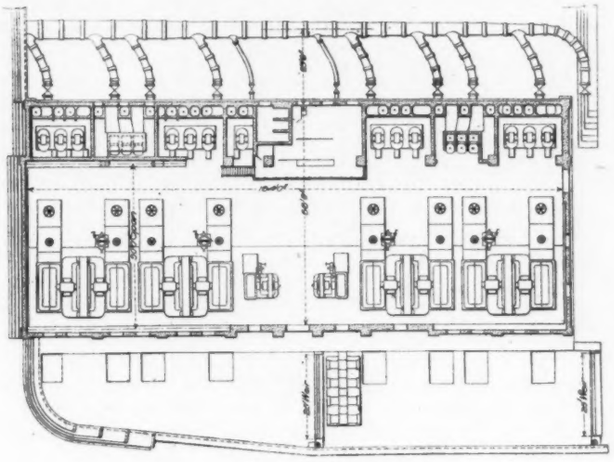


FIG. 19.—PLAN OF POWER HOUSE.

it is necessary to discharge the water from the wheels in such a direction and at such an elevation that it will flow by gravity into their intake.

The Kern River is subject at times to very considerable floods, and the elevation of the header pipe and consequently of the water wheels was made sufficiently high to permit of running the units even when the stream is at its maximum flood.

The foundations were started on bed-rock and cemented, boulders low enough to avoid any possibility of the power house being undercut by floods, and the walls were constructed in such a manner that no important machinery rested on floors placed on backfill. All spaces between these walls, except those which could not be utilized on account of their falling so low as to be subject to flood, were filled in with compact backfill from other portions of the work.

The available area was so crowded that it was necessary to make a deep excavation in the hillside to accommodate the inner or eastern end of the building. The debris from this cut and from the tailraces was wasted on the south side of the building as a dump upon which the header and branch piping from the pressure main were placed. On the north side of the station the spoil bank filled in a triangular area of the flat wash, raising its entire area above maximum high water and producing a bulkhead which will protect the power house against any possible flood.

The foundations proper are of monolithic concrete. The rock and part of the sand for the aggregate were secured by crushing granite boulders excavated from the site, as well as a large amount of rock which was lying on the pressure-tunnel dump. Additional sand was secured for a time from various small bars in the river adjacent to the power house. These were, however, covered by high water early in the year, and after that time all necessary make-up sand was hauled from the mouth of the cañon, about two and one-half miles distant.

The upper part of the machine foundations carries a small amount of reinforcement. The large block of masonry back of each water-wheel deflector is heavily reinforced and tied into the main foundation blocks. The crane-rail arches for the interior wall are reinforced concrete beams, with the exception of the long span above the switchboard, which contains an I-beam girder. By reason of the length of the building and the importance of the work, no account was taken in its construction of the additional strength resulting from the continuity of the beams, the bridging effect of the crane rail, nor its cushioning timbers, nor was any allowance made for the 12-in. curtain walls, which fill in below this beam in places. The north wall, however, is a 12-in. curtain wall reinforced with heavy pilasters, and contains only sufficient reinforcement to render it reasonably secure against shock and vibration. The south wall of the building is of a cellular construction for about two-thirds of its height, in order to provide wiring ducts for the 60,000-volt connections. This wall also contains only

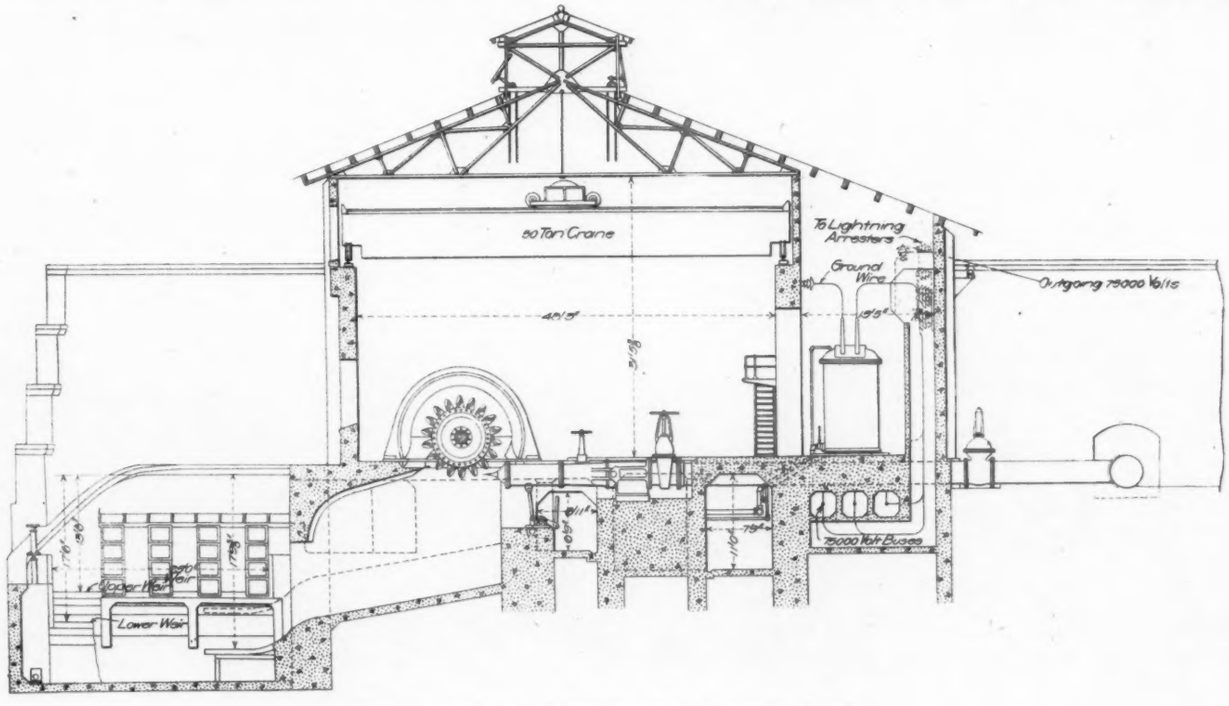


FIG. 20.—VERTICAL SECTION THROUGH POWER HOUSE.

nominal reinforcement. Between this wall and the interior crane wall, a space 15 ft. wide, a series of transverse partitions break up the area into transformer, switch and switchboard rooms. The transformer rooms are open up to the crane beam to permit of wheeling the transformers out under the main crane. The crane-rail columns are not highly stressed and have no hooping whatever. A 50-ton electric traveling

crane, with a 50 ft. span, built by Maris Bros., serves the entire machine room.

The switchboard space contains a deck 8 ft. 6 ins. above the main floor level, upon which the control board is mounted.

The roof of the building is of galvanized iron laid on wooden purlins, which are placed on steel roof tresses of 52 ft. 1 in. clear span. The internal length of the machine room is 164 ft., and its clear width is 66 ft. 6 ins. The generating units are located along the north side of the station, 78 ft. from the center of the pressure header.

OTHER HYDRAULIC FEATURES.

Dead water leaving the water wheels flows down the floor of the wheel race into the main tail race. When the nozzles are deflected the water is diverted past the buckets onto a pair of heavy metal deflector plates.

Fig. 21 shows the water being discharged from the deflected nozzles of hydro-electric unit No. 1. These deflector plates are 7 ft. wide, and the lower one projects out into the tail race 8 feet.

The speed regulation of the water wheels is effected by a governor which deflects the jets of the two nozzles. The needles are adjusted by hand and are usually set to that maximum size of jet which will be sufficient to develop the maximum peak load expected for that period of setting on the needles. In other words, there is always a maximum amount of water leaving the nozzles. The governor adjusts the deflecting nozzles in such a way that only as much water is directed upon the buckets as is needed for the load for the time being; the balance discharges below the buckets into the tail-race. It is evident that at times when all load is thrown off the wheels, the governor will deflect the jets entirely. Each jet has a maximum diameter of 7⅜ ins. and leaves the nozzle tip at a velocity exceeding 225 ft. per second. It was, therefore, necessary to provide means for receiving the tremendous force and for deflecting the jet into the tailrace.

FIG. 21.—TAIL RACE, SHOWING WATER DISCHARGING OVER DEFLECTOR PLATES.

The arrangement designed consists of the pair of heavy deflector plates onto which the jet is diverted, as noted above. The upper of these plates consists of a channel heavily ribbed and bolted to the concrete foundation. The channel at its upper end is slightly more inclined than the deflected jet. Thus the jet strikes the bottom of the channel under a small angle and, therefore, tends to spread and fill the section of channel. The channel gradually widens and, consequently, the jet is offered a larger resistance area. The lower part of the channel is curved, and at its end the jet discharges almost perpendicularly downward. The bottom plate is S-shaped, its upper end being flush with the bottom of the wheel pit, the lower end practically level. The jet strikes the bottom plate almost in the turn of the "S" and under a small angle. Thus the jet is again forced to spread and follow the base of the bottom plate. In due consideration of the unavoidable wear and tear of these deflectors, they are lined with removable steel plates wherever the surfaces are exposed to the flow of the deflected jet, being held in position by lag screws.

The wheel races are lined with steel on both sides and fitted with steel plates just back of the nozzle tips to keep the splash water out of the shaft alley.

The tail race is 29 ft. wide, and extends the length of the power house. It is fitted with two 25-ft. steel-plate weirs, the lower weir at the end of the tail race being 4 ft. below the level of the upper weir which has its crest 13 ft. 6 ins. below the line of the nozzles.

The water-wheel branch pipes enter the power house at the south side and after passing across under the transformer room and before joining the nozzle bases, connect to 28-in. cast-steel gate valves. These valves are of a special design, and each is operated from the control switchboard by a 1.2-hp, 120-volt Allis-Chalmers motor. It requires 7½ minutes to open or close a valve by means of the motor. Each gate valve is equipped with a 4-in. by-pass.

In the machine room of the power house is installed a Dibble reservoir gauge equipped with an indicating dial and a registering chart for measurements of the water in the forebay.

CONCRETE USED FOR CONSTRUCTION WORK.

As will be noted from the description above, concrete entered largely into the construction of the Kern River No. 1 plant. This concrete was made from hydraulic Portland cement, all of which passed the specifications of the American Society of Civil Engineers. The mixture used, except for the pressure tunnel, consisted of one part of cement, mixed with broken stone five parts, and sand three parts, all by volume. All of the broken stone or crushed rock used was crushed to sizes which would pass through a 2-in. ring, the material being taken from tunnel waste deposited at the portals of the different tunnels during excavation. Very little sand could be obtained from the river, so that fully nine-tenths of all the sand used was also prepared from tunnel waste by passing the crushed rock through sand rolls.

CONSTRUCTION PLANT.

A construction plant generating 300 kw at normal rating was installed for furnishing the energy used in driving tunnels, mixing concrete, transporting materials, etc. This construction plant was located at Frenchtown, or Camp 5, power being developed by means of a flume about 800 ft. in length which supplies water under 40-ft. head to two McCormick reaction turbines each operating one 150-kw, 2300-volt generator. This plant furnished all the energy required while the work was in progress, being frequently and for long periods operated at 50 per cent overload, and was abandoned only after the completion of the main plant. From the construction plant, energy was transmitted at 10,000 volts to all parts of the work over a temporary transmission line.

METHODS OF CONSTRUCTION.

It can be said that the methods of construction employed were among the most modern known to engineering practice. For constructing the tunnels, air compressors were driven by motors using electric energy transmitted from the construction plant, as already stated, the air being piped into the various tunnels where it was used for operating pneumatic drills. Ventilating blowers for supplying fresh air at the face of the tunnels and for removing the fumes after a blast were operated by electric motors. In the construction of the diverting dam, a complete system of cableways designed by the company's engineers was installed, by means of which material was transported and placed in position in the dam. In the construction of the power house, the handling of materials as well as the crushing of rock and mixing of concrete was carried on by means of the most modern equipment operated by electric motors.

As has already been mentioned, the Edison Electric Company carried on all the tunnel excavations with its own men. The power house was also erected by the company. Glass & Fischer had the contract for all the concrete work on the job, except the power station; their work covering the construction of the dam, the lining of the tunnels and the backing of the steel lining in the pressure main.

Catenary Line Construction on the New York, New Haven & Hartford Railroad.

DURING the present month the steam locomotives used for handling the trains of the New York, New Haven & Hartford Railroad throughout New York City and its suburbs are being superseded by electric locomotives. On another page of the present issue is to be found a complete official discussion of the facts which caused the abandonment of steam in favor of electricity and which led to the adoption of high-voltage low-frequency alternating-current locomotives as the best available equipment for the propulsion of the trains. Below there is given a description of the catenary line work, which is one of the distinguishing features of the New Haven electrification. In subsequent issues descriptions will appear of the Cos Cob generating station, from which electrical energy is obtained for train propulsion, and additional accounts will be given of the single-phase locomotives, which were described at some length in our issue for April 14, 1906.

The electric trains of the New York, New Haven & Hartford Railroad leave the direct-current zone of the New York Central at Woodlawn, N. Y., and pass onto the alternating-current line of the New York, New Haven & Hartford Railroad, which at present extends as far as Stamford, Conn. Upon this section, as is well known, 11,000 volts are employed. The catenary construction, as well as the supporting bridges, were illustrated and briefly described in our issue for March 30, 1907, when an account was given of the method of erecting the bridges. It is the intention at this time to present an account of the details of the over-head work.

OUTLINE OF OVERHEAD SYSTEM.

The supporting bridges are of varying lengths, so as to accommodate four, five, six, or as many as twelve tracks, as the local conditions require, and are of two types, anchor bridges which are used only at intervals of about two miles, and intermediate bridges. The latter have side posts of square cross-section, and are of comparatively light construction. On the other hand, the anchor bridges have A-shaped posts and are made heavier to withstand the strain of the cables.

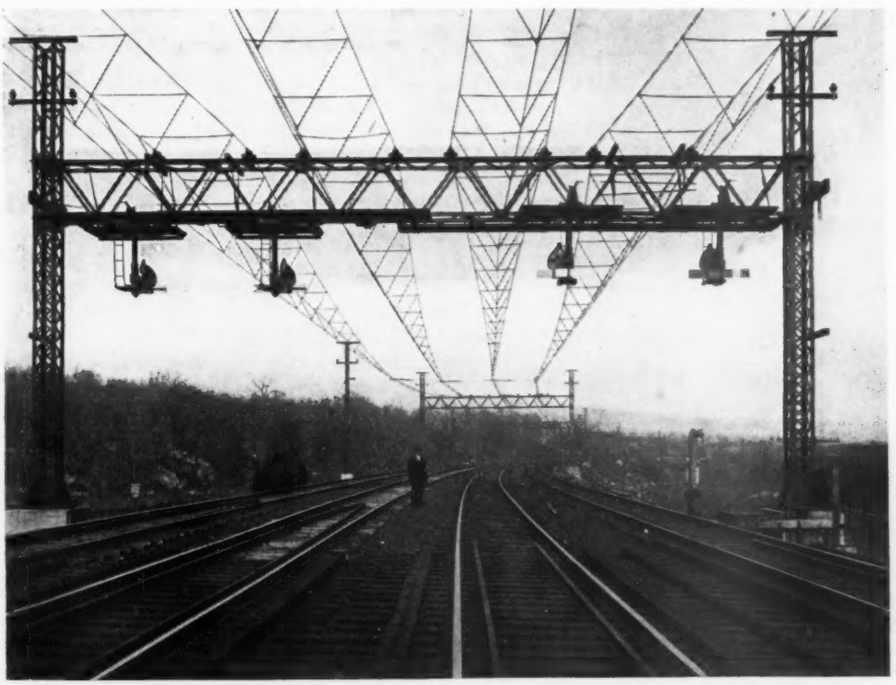


FIG. 1.—INTERMEDIATE BRIDGE EQUIPPED WITH SEMAPHORE SIGNALS.

The anchor bridges are provided with automatic circuit breakers, by means of which the different sections may be isolated, and also the several parallel tracks may be electrically separated from one another in case of accident to any one track. The anchor bridges also carry lightning arresters, shunt transformers for operating the circuit breakers, together with foot walks, hand railings, lamp circuits and the wires and conduit for the auxiliary control circuits.

The working conductors have sufficient area for the working current, but two auxiliary feeders extend along the entire length of the line from Stamford to Woodlawn. These feeders are connected with the main conductors at each anchor bridge through circuit breakers and provide means for feeding around any one section in case it is cut out of service on account of some accident in that particular section.

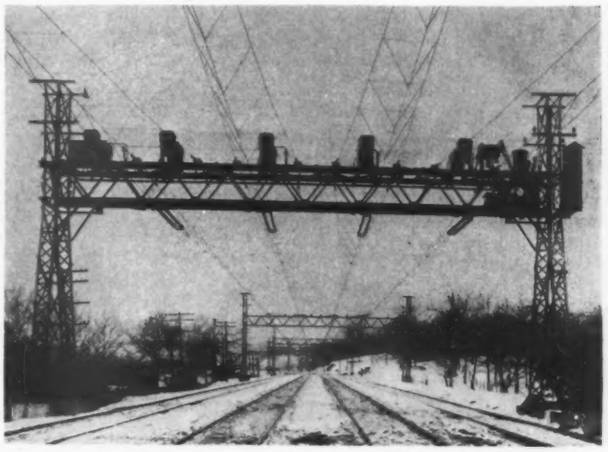


FIG. 2.—ANCHOR BRIDGE NEAR PELHAM STATION.

Provision is also made on all of the bridges for carrying two separate feeder wires called "power feeders," which are connected to the third phase of the generating system and are used for operating three-phase apparatus at certain intervals along the road. Provision is also made on the bridges for carrying two three-phase circuits, one circuit being supported on the top of each post at the ends of the bridges.

In laying out the bridges for the section from Woodlawn to Stamford, it was found that the sharpest curvature was 3 degs. As this curvature will permit of stringing the trolley wire in straight lines between points of support 150 feet apart without deviating from the center of the track more than 8½ ins. on each side, it was decided to place all bridges a fixed distance of 300 feet apart, and on curves to provide guy poles to which pull-over wires are attached and secured to the catenary spans (see Fig. 1). By this means a minimum amount of overhead wiring was obtained, and the deviation from the center of the track was maintained within safe limits for use in connection with the sliding pantograph trolleys on the locomotives, the bow of which is 4 feet long.

INTERMEDIATE BRIDGES.

The general appearance of the standard four-track intermediate bridge is shown in Fig. 1. This illustration shows also signals mounted on the bridge, the semaphore blades being located below the truss so as to afford an unobstructed view. As will be noted, the bridge consists of two supporting side

posts and a horizontal truss. Each supporting post is approximately 38 ft. long by 1 ft. 10 ins. square. Each is composed of four 4 in. x 4 in. x 7/16 in. angles secured together by 2¼ in. x ⅜ in. lacing bars.

Each post rests upon a concrete foundation, containing about 9 cubic yards of concrete. Anchor bolts extend entirely through the concrete foundation and hold the base of the post to the foundation by means of heavy nuts. The cross-truss is attached by means of bolts to the vertical posts, allowing a distance of 23 ft. 4 ins. from the lower side of the truss to the top of the rails. The truss is 4 ft. 6 ins. deep from back to back of the upper and lower chord angles, which latter are placed 1 ft. 10 ins. from back to back. The lacing bars of the upper chord are depressed below the upper surface of the chord angles so that the latter are left free from rivets or other obstructions, thereby affording a ready means for attaching the insulators at any point. The lacing bars of the upper chord consists of flat strap, while the diagonals in the sides and bottom of the truss

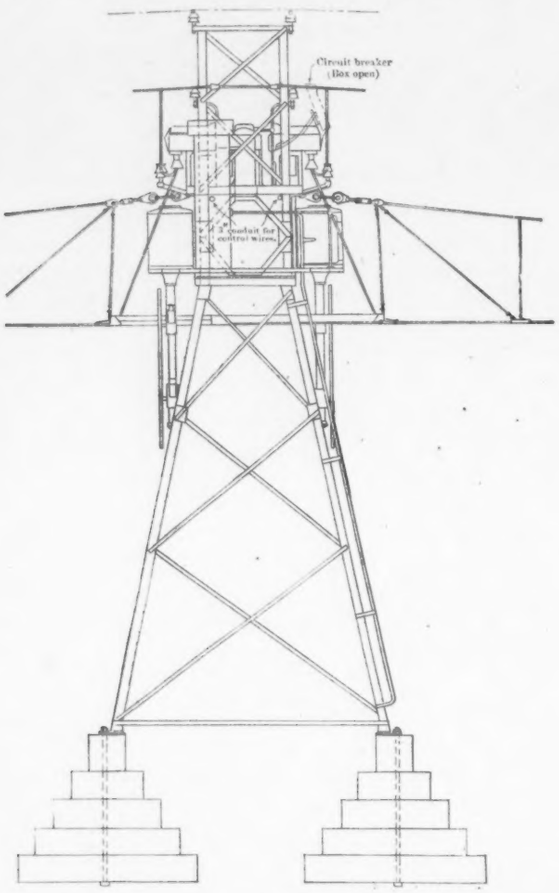


FIG. 3.—END VIEW OF ANCHOR BRIDGE.

consist of angles. The upper chord angles are 3½ ins. x 6 ins. x ⅜ in., and the lower are 4 ins. x 3½ ins. x 5/16 in.

The extensions of the side posts above the trusses are utilized for supporting the feeder wires which are carried upon angle-iron cross-arms bolted to the posts. The lower cross-arm carries two insulators, upon the inner one of which is carried the auxiliary feeder. The upper cross-arm is located 5 feet above the lower one and carries two wires of the three-phase circuit. The third wire of the three-phase circuit is carried upon a light vertical channel-iron support.

In the calculation of these bridges very heavy weather conditions were assumed, and provision was made for clamping the catenary cables on the intermediate bridges so that they are obliged to partially withstand the longitudinal pull of the latter. It was assumed that the entire system of the bridges and cables might become coated with sleet, and that this coating might be one-half inch in thickness around all surfaces. It was assumed also that the wind pressure on the bridges and the catenary spans might at the same time be as high as 25 lbs. per square foot. It was further assumed that the effective area of all round cables would be two-thirds of their projected areas.

Each catenary cable is clamped to its supporting insulator on every intermediate bridge, and it was assumed that if one pair of cables should be broken, the remaining cables would exert a balancing influence on the bridge. The truss, however, was made strong enough to prevent its buckling under the strain produced by the breakage of any pair of cables.

ANCHOR BRIDGES.

Anchor bridges of especially heavy construction are placed every two miles, and against these bridges the catenary cables are anchored. Fig. 2 gives a view of a standard four-track anchor bridge with the auxiliary apparatus mounted upon it. The four-track anchor bridge consists of two A-shaped posts, each having a spread at the base of 15 ft., and a width at right angles to the track of about 2 ft. The main members of these posts consists of 6-in. x 4-in. x ⅝-in. angles. These posts are also extended above the truss in the manner shown in the illustration for the purpose of carrying the feeder wires. The truss is bolted to the side posts, allowing a clearance above the rails to the lower side of the truss of 24 ft. 3 ins. The truss is 4 ft. 6 ins. deep by 5 ft. wide between the backs of the chord angles. The upper chords consist of 8 in. x 8 in. x 9/16 in. angles, and the lower chords consist of 4 in. x 3½ in. x 9/16 in. angles.

Fig. 3 represents the side view of the anchor bridge, and Fig. 4 a plan view of the same bridge from which additional details of the construction may be noted. A ladder is provided on one of the posts leading to a small platform at the end of the truss. This platform is provided with a hand rail and carries upon it a box containing an 11,000-volt, low-equivalent lightning arrester. A portal is provided in the end of the truss, by means of which the attendant may step onto the platform supported upon the lower chord of the truss. From this platform access is provided to the short ladders leading to the signal lanterns, and a second short ladder extending up to another 2-A platform supported upon the upper chord of the truss. This platform, a view along which is given in Fig. 5, is surrounded by a hand rail, which is also attached to the iron supporting frames of the circuit breakers in such a manner that the attendant can in no way come in contact with live parts of the circuits. At each end of the truss a 5-kw, 11,000-volt shunt transformer is provided, one of them being connected directly into a bus-bar which runs around the outside of the circuit breakers and which is supported upon porcelain insulators and bus-bar brackets, secured to the upper chords of the truss. The other transformer is connected directly into one of the "power" feeders. As the "power" feeder is connected to the third phase of the generating system, means are available for operating the switches in case of accident to the trolley section. The four-track anchor bridge is secured to concrete foundation by means of long anchor bolts and nuts. Each post rests upon blocks of concrete, each block containing about 12 cubic yards of concrete.

CATENARY CABLES.

Each of the two catenary cables which support the copper trolley conductor consists of an extra high-strength steel cable, 9/16 in. in diameter, consisting of seven strands. This steel has an ultimate strength of about 200,000 lbs. per square inch, and each strand is heavily galvanized. The completed cable has a total strength of 33,800 lbs. These cables are strung between the bridges with a sag at mean temperature of 6 ft. in a standard span of 300 ft. Owing to obstructions at certain places along the right of way, the spacing of the bridges is occasionally varied from the standard distance of 300 ft. In order to allow for this the cable is run out in long lengths and is pulled up to a uniform tension until the sag in the span of 300 ft. is 6 ft. The sag in the other spans is allowed to adjust itself, since the tension is the same. After being pulled up to the proper tension the catenary cables are anchored to the

anchor bridges and are clamped to the insulators of the intermediate bridges.

MAIN LINE INSULATORS.

The insulators which support the catenary cables of the intermediate bridges consist of heavy porcelain insulators of the skirt type, which are 15 ins. in diameter and about 7 ins. high. These insulators are cemented upon short lengths of double, extra strong pipe, which in turn is held by means of U-bolts to a cast-iron yoke, bolted to the upper chords of the truss. The catenary cable rests in a groove in the top of the porcelain and is held by means of a malleable-iron clamp fitted with U-bolts and placed one on each side of the insulator. The head of the insulator is conical in shape and is surrounded by means of a split malleable-iron clamp and a lead packing. Fig. 6 represents the main line insulator complete with its supporting yoke.

One feature of the construction to be noted is the arrangement of the clamp and the collar, which is such that in case of the breakage of the messenger cable on one side of the insulator, the pull of the cable on the other side will cause the clamp to swing downwards, thereby lowering the point of application of the pull of the cable. Thus the porcelain is put in compression, and there is no tendency to shear off the top of the porcelain, as is usually the case with porcelain line insulators. Each porcelain is subjected in the shop to a test of 55,000 volts when assembled.

FIG. 5.—VIEW ALONG PLATFORM ON ANCHOR BRIDGE.

ANCHOR BRIDGE STRAIN INSULATORS.

Fig. 7 represents the general appearance of the strain insulators which are used for dead-ending the catenary cables at the anchor bridges. These insulators, which are of special construction, are designed to withstand a shop test of 50,000 volts and a working load of 20,000 lbs. Each consists of a length of 2 in. extra heavy iron pipe, surrounded at its middle point by an iron collar. Outside of this collar a long insulating tube, composed of especially hard and reliable insulating material, is pressed. This tube is surrounded by a second collar into which a bolt is screwed and to which the turnbuckle of the catenary cable is attached. The entire surface of the insulating tube and the inner and outside collars are then effectively sealed against moisture by means of a high-grade insulating compound applied by means of hydraulic pressure. The insulator thus made up is supported by means of an iron yoke from cast-iron hooks bolted to the upper chords of the anchor-bridge truss.

One of these insulators is provided in each catenary cable at each anchor bridge, thereby electrically dividing the road up into separate sections between the anchor bridges.

GUY POLES.

Midway between the supporting bridges and curves a guy pole is located on the outside of the curve. These guy poles are of two types, namely, rigid and anchored, the former being used wherever there is room on the right of way for the anchorage, while the latter is used in places where the width of the right of way is restricted. A pole of the latter type is seen in place in Fig. 1. Heavy strain insulators are attached to the guy poles at the proper height, and pull-over wires are attached to this strain insulator and to the catenary cable and trolley wires of the several tracks.

The strain insulator is somewhat similar in appearance to the

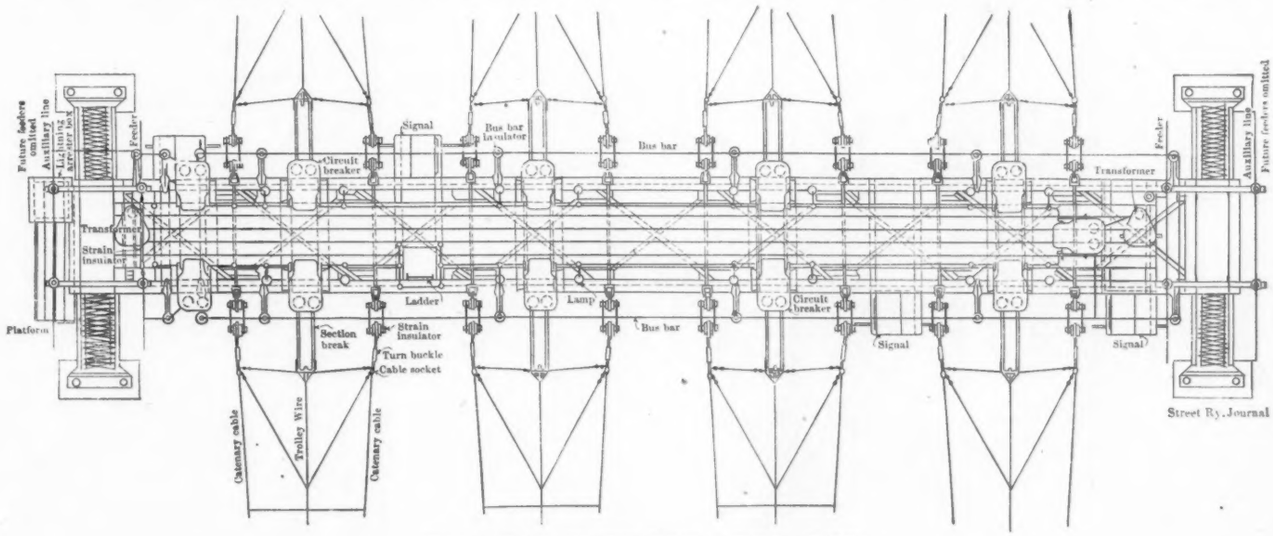


FIG. 4.—PLAN OF FOUR-TRACK ANCHOR BRIDGE.

well known "giant strain," except that it is designed to withstand a test of 50,000 volts, and a mechanical pull of 15,000 lbs. It is made up of steel castings and solid mica insulating cones and is sealed with a high-grade insulating compound. These strain insulators are attached by means of one loop in the guy poles, and the pull-over wires are attached to the other loop.

INSULATING SEPARATORS.

In order to enable any one track to be electrically disconnected from any other parallel track when the circuit breakers

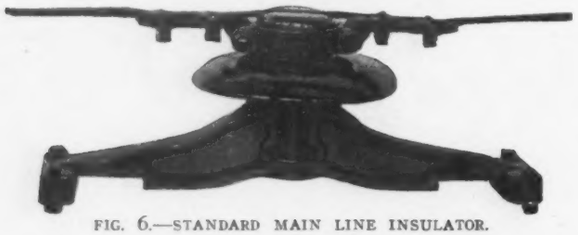


FIG. 6.—STANDARD MAIN LINE INSULATOR.

on the anchor bridges are open, insulating separators are provided in the pull-over wires between the tracks (see Fig. 1). Each separator consists of a 5-ft. rod of selected hickory, thoroughly impregnated and fitted at the ends with malleable-iron heads secured to the conical-shaped heads of the rods by means of bolts. Each insulator has an ultimate strength of about 16,000 lbs. At no point in the entire construction is wood relied upon for insulation to ground, and it will be noted that these wooden separators normally have no difference of potential upon them. They are merely provided in case of accident, when

FIG. 7.—STRAIN INSULATOR.

it is necessary to isolate one section of track from another. They are, however, subjected to a test of 30,000 volts.

TROLLEY HANGERS.

The trolley wire is supported from the catenary cables at 10-ft. intervals by means of triangular trolley hangers of varying lengths. These hangers are so adjusted in length that the trolley wire is maintained in a horizontal position (Figs. 1 and 2), it being 6 ins. below the catenary cables at the middle point of the span. The hanger consists of a pair of small drop-forged steel jaws, which engage with the grooves of the trolley wire and are clamped by means of a malleable iron Y, which is screwed down upon the threaded portions of the jaws. The sides of the triangle are then screwed into the Y and are bolted to the messenger cable above. As all of the threads are right handed, it is impossible for the hanger to come loose.

TROLLEY SECTION BREAK INSULATORS.

At each anchor bridge it is necessary to provide an insulator in each trolley wire, and this is accomplished by means of the piece of apparatus shown in Fig. 8. Each consists of two bronze end castings, to which the ends of the trolley wire are bolted. Two parallel sections of impregnated hardwood are fastened to these castings, and to these wooden strips are fastened renewable pieces of trolley wire in such a manner that the ends of these renewable pieces overlap one another in distance along the track, although the two wires are electrically distinct. By this means it is possible for the sliding contact on the locomotive to pass from one section to the next without opening the circuit, thus avoiding all flashing. It will be noted, however, that an effective insulation is provided so that when the circuit breaker on the anchor bridge is open, the two sections will be disconnected. The manner in which this section insulator is installed is clearly shown in the end view of the anchor bridge, Fig. 3. Insulators in place under an anchor bridge are shown in Fig. 2.

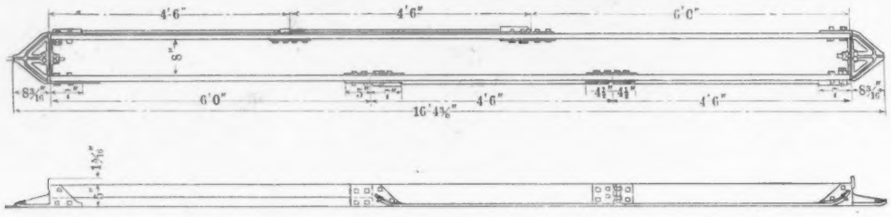


FIG. 8.—SECTION INSULATOR.

LOW BRIDGE CONSTRUCTION.

At a number of points along the road overhead bridges reduce the clearance above the tracks. The construction consists of a corrugated porcelain spool, mounted upon an iron pipe, which in turn is supported at each end from a skirt-type porcelain insulator, of the same design as that used on the intermediate bridges. The messenger cables where they pass under the bridge are heavily insulated, and the hangers which support the trolley wire from the messenger cable are placed midway between the porcelain insulators so that the maximum amount of flexibility is obtained. The trolley wire hangers are constructed of impregnated wood, so that the trolley wire is completely insulated from the catenary cables. A waterproof shield is attached to the bridge above the insulating structure so as to prevent accumulations of dirt and water on the insulators.

AUTOMATIC CIRCUIT BREAKERS.

The type of circuit breaker which has been developed for this installation is shown in Fig. 9, which gives the details of the device, while Figs. 2 and 5 show the breakers in place on the anchor bridges.

The breaker consists of a cast-iron framework adapted to be bolted to channel irons resting upon the upper chords of the anchor bridges. This framework carries an iron box provided with a hinged cover. This cover is arranged to fit tightly in place so as to exclude all rain and snow and be entirely weatherproof. The moving parts of the circuit breaker are contained within this box and are made especially rugged and reliable in their operation. The terminals of the switch are brought out through specially constructed insulators mounted in an overhung portion of the box at the rear (Fig. 9). Upon

the tops of insulators are carried knife-switch jaws, and there are corresponding jaws mounted on the upper ends of the circuit breaker contacts. Two switch blades are carried on insulating pillars fastened to the hinged cover of the box in such a manner that when the cover of the box is closed one terminal of the switch is connected to the bus-bar on the anchor bridge and the other is connected to the trolley wire. Arrangements are provided so that if the cover is opened the circuit breaker

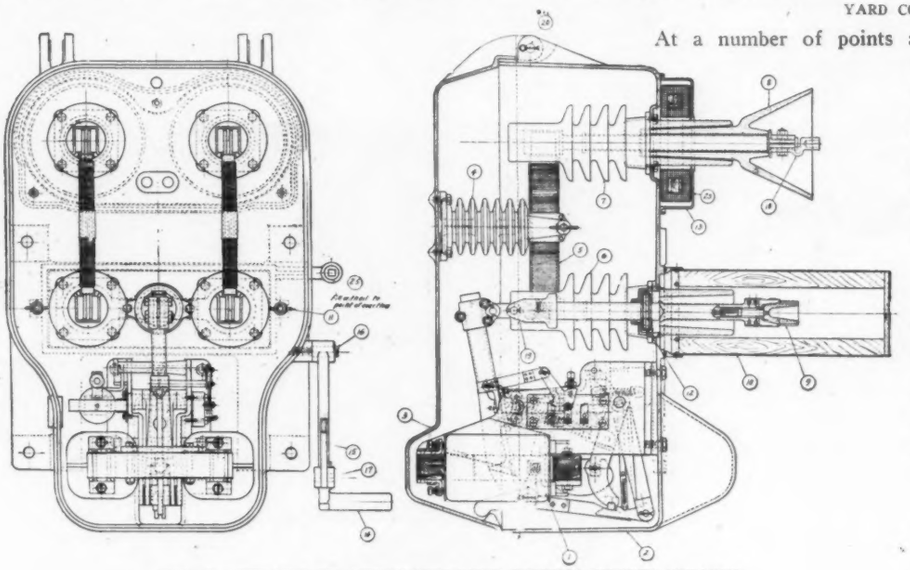


FIG. 9.—DETAILS OF AUTOMATIC LINE SECTION CIRCUIT BREAKER.

will be automatically tripped so as to prevent any possibility of the attendant taking hold of live parts.

The circuit breaker is capable of handling 11,000 volts on heavy, short circuit. A tripping coil is provided, together with closing magnets, both of which are operated from a circuit supplied from the small shunt transformers on the anchor bridge. The switch is also arranged to open automatically on overload.

The control wires for the closing magnets and the tripping coils are carried in iron conduit and lead-covered cable to the adjoining signal tower, where a switchboard panel is provided. This panel is fitted with switches so that any circuit breaker may be tripped by hand, or closed by the attendant in the signal tower. There is also a switch by means of which the attendant may connect either of the shunt transformers on the anchor bridge to the control circuit.

The auxiliary feeders, which are supported on the inner insulators of the lower bracket arm on the bridges, are looped in to the bus-bars on each alternate anchor bridge. These connections are made through automatic circuit breakers, so that in case of the grounding of the bus-bar structure to any anchor bridge, one of the auxiliary feeders will pass around the grounded bridge to the next section beyond. On each anchor bridge one auxiliary feeder is broken by a strain insulator, and connections are made through circuit breakers to the bus-bar. The other auxiliary feeder is carried directly through, and a single tap connection is made from the feeder through the circuit breaker to the bus-bar. Upon the next bridge these conditions are reversed, so that each auxiliary feeder is divided into 4-mile sections. This arrangement provides a maximum flexibility of control.

YARD CONSTRUCTION.

At a number of points along the road, where there are numerous side-tracks, it is necessary to provide extra long bridge supports. Fig. 10 represents one of these long bridges, which is designed to cover 12 tracks. The catenary cable insulators are attached to the lower members of the truss.

TRACK BONDING.

Both rails of all tracks are bonded by means of No. 4-0 compressed terminal flexible bonds placed around the fishplates. It will be recalled that the trolley itself consists of standard No. 4-0 grooved copper.

TURN-OUTS AND CROSS-OVERS.

Whenever one track diverges from another a section insulator is inserted in the trolley wire. Insulators are also inserted in the catenary cables supporting the diverging wire between parallel tracks. The diverging trolley wire is connected to the main wire by means of a frog of standard design and in order to prevent the contact shoes on the locomotive from catching, deflector wires are placed in the angle between the trolley wires. These deflectors are carried by yokes secured to the trolley wire and are attached to yokes at the rods which are fastened to the catenary hangers. There being a certain amount of flexibility in the overhead trolley system, when the bow is pressed upward against the contact wire, this wire is raised above the level of the other contact wires in the immediate neighborhood. Thus, certain portions of the short length of trolley wire used to interconnect the two main trolley wires at cross-overs would tend to remain in a plane below that of the active trolley wire as the locomotive passes this point. The deflector wires are designed to tend to cause the cross-over trolleys and the main trolley to be raised partly in unison by decreasing the upward movement of the main trolley and increasing the upward movement of the cross-over trolley. The contact bow of the trolley mechanism on the locomotive is given a certain amount of upward curvature towards the center, so that the bow has no tendency to catch in either the cross-over trolley wires or the intermediate deflector wires.

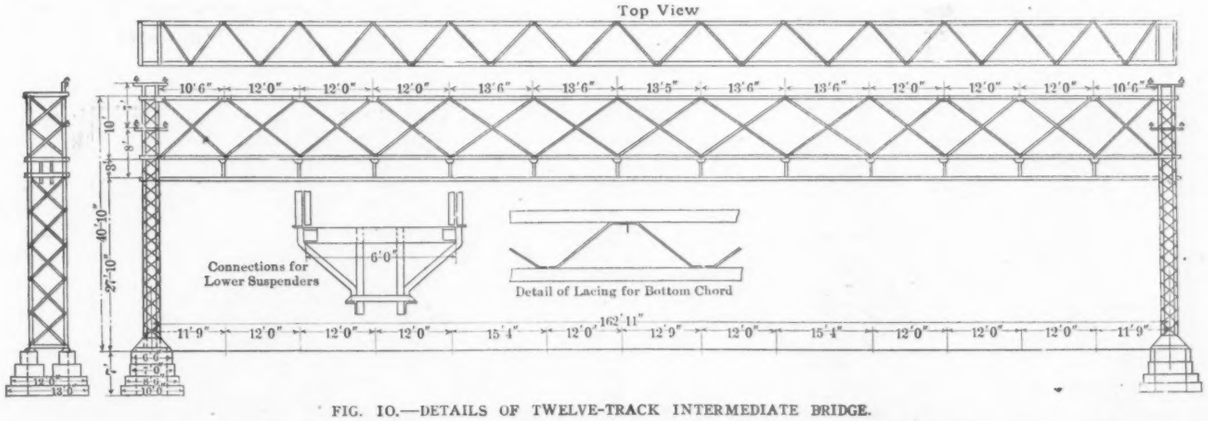


FIG. 10.—DETAILS OF TWELVE-TRACK INTERMEDIATE BRIDGE.

The Fuel-Testing Plant of the United States Geological Survey at the Jamestown Exposition.

The fuel testing work of the United States Geological Survey should be followed with close interest by all engineers, not only because it is important to all fuel consumers, but because this branch of the Government work is undertaken to point out new paths for the development of the natural resources of the country by locating, classifying and testing all kinds of available fuel.

Accurately compiled results of the more recent work of this branch will soon be published, and the following particulars of the plant at the Jamestown Exposition will doubtless be of interest.

Fig. 1 shows the plan of the Power and Alcohol Building in the grounds of the Jamestown Exposition, indicating the location of the boilers, gas producers and engines, nearly all of which apparatus was used at the St. Louis Exposition by the Geological Survey in conducting somewhat similar tests.

STEAM ENGINEERING DIVISION.

New apparatus has been added to this division as follows: A 250-hp Babcock & Wilcox boiler, with superheater, provided with a Roney stoker (Fig. 2); a Jones underfeed stoker with fan, added to one of the old Heine boilers; two direct-current De Laval turbine sets (Fig. 3) rated 300 horse-power at 9000-900 revolutions; also three Green Fuel Economizer Company's induced draft fans.

The method of work planned for this section is to be slightly changed, so that instead of testing a great number of coals, more tests will be made of the same coal, different sizes and different methods of stoking or feeding, etc., being employed with the object of determining the most economical performance under different rates of combustion and the best ratios of grate and heating surfaces.

The B. & W. boiler will be placed beside the two Heine boilers which have been brought from St. Louis, all three having been provided with induced draft apparatus in order to get a wide range of capacity. The Heine boiler provided with the Jones stoker has the usual arrangement for forced draft. The B. & W. boiler was inserted partly to enable tests to be made of the same fuel with different types of boilers. It serves to represent the types employing a perpendicular flow of the gases through the tubes, the parallel flow types being represented by the Heine boilers. The Heine boilers have been rebaffled or partitioned in such manner as to practically double their length by compelling all the heated gases to pass along the entire length of the tubes twice.

An additional alternating-current turbo-generator set may be installed as indicated to supply power for external and exhibition purposes.

The steam engineering division, which has now practically succeeded in isolating the performance of the boiler from that of the combined performance of the boiler and furnace, will carry on further tests with the object of still further determining the performance and efficiency of the furnace alone.

PRODUCER GAS SECTION.

The apparatus in the producer-gas section is arranged as shown in Fig. 1 and Fig. 6; the producer gas, immediately on entering the building, passing through the meter and thence to the Westinghouse gas engine, shown in Fig. 4, transferred from the St. Louis plant. Some slight changes have been made in this apparatus. For instance, producer No. 7 has been provided with a water seal at the base to permit the ashes to be removed without admitting air, and several holes have been bored at different heights to be used for extracting samples of the gas. The purifying apparatus used at St. Louis has been removed; (this, it will be remembered, consisted of the usual chamber containing iron filings and wood shavings) since experience indicates that the danger from impurities has been considerably exaggerated.

A special steam pipe has been provided to insure a steady water pressure, since the pressure of the supply mains fluctuates considerably.

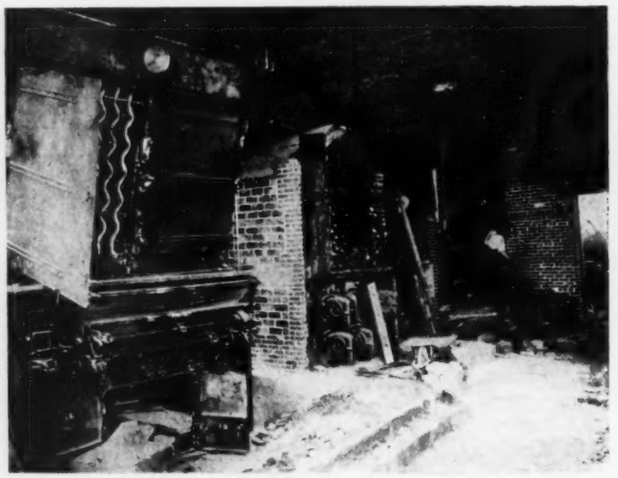


FIG. 2.—INTERIOR OF BOILER HOUSE.

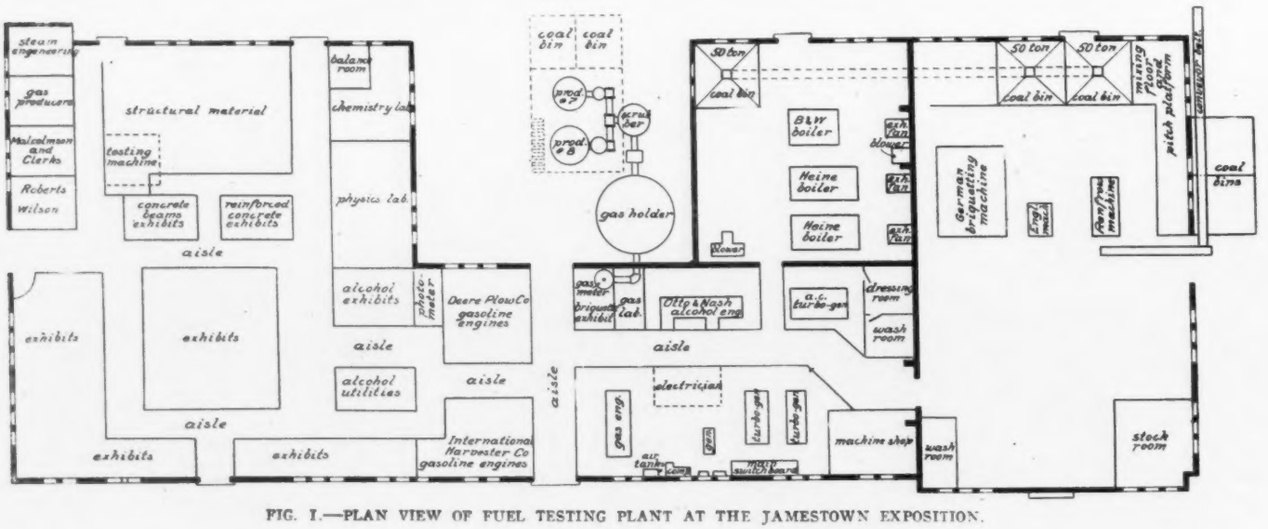


FIG. 1.—PLAN VIEW OF FUEL TESTING PLANT AT THE JAMESTOWN EXPOSITION.

The gas engine is belted to a 200-kw Bullock generator, brought from St. Louis, which serves to drive the motors for the apparatus in the building, the machine shop, the briquette plant, the elevators and the conveyor. Any additional load required is obtained by means of a water rheostat, which can be regulated by the switchboard attendant so as to maintain a steady full-load value.

The plans of this section include the following determinations: The proper length for a test run, the effect of the size of the coal, the best depth of fuel bed, the effects of rapid load variations, the maximum returns from different fuels, and

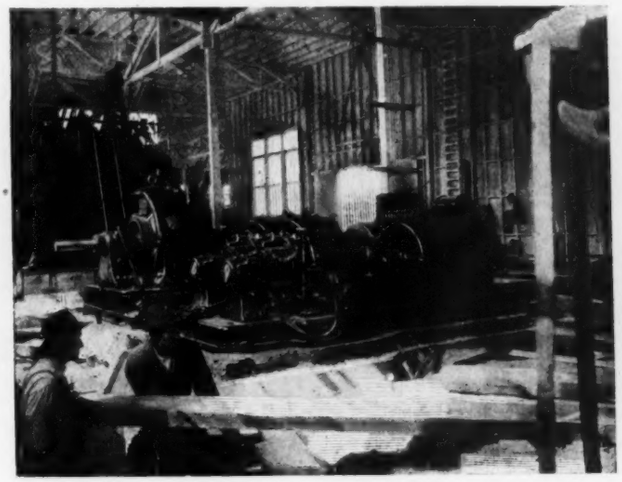


FIG. 3.—DE LAVAL TURBO-GENERATOR SETS.

the response of a producer plant to sudden demands for power.

ALCOHOL AND GASOLINE ENGINES.

A new work of great importance is being undertaken by this section. Its equipment includes two 15-hp, 250 r. p. m. Otto gas engines; two 15-hp Nash Company's engines; one 2-hp International Harvester Company's engine, and two John Deere engines rated at 14 and 18 horse-power, respectively.

Experiments will be made covering the whole range of this field, but for the present the work will be confined chiefly to

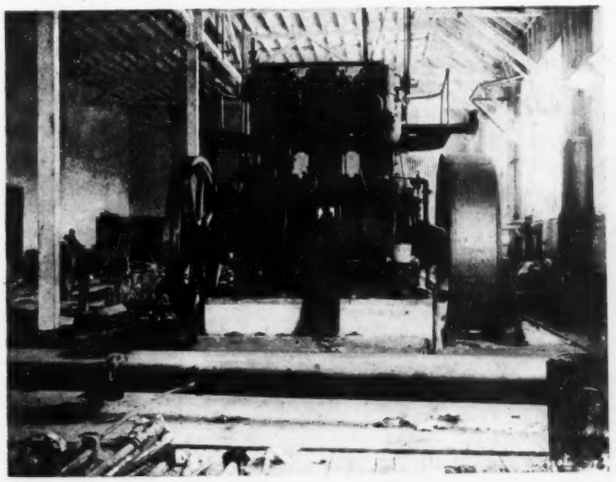


FIG. 4.—225-HP GAS ENGINE.

examinations of different carburetters with the object of showing the lines along which a more efficient method of vaporization may be obtained. The other more prominent work is the examination of the kinds of fuels available, with special reference to gasoline versus alcohol, and an investigation of the use of kerosene as fuel for this class of engine, an investigation necessitated by the increasing demand for gasoline and the limited supply available.

DISTILLATION OF COAL AND COMBUSTION.

The study of the destructive distillation of the coal and its combustion in gas producers, coke ovens and furnaces, especially from the standpoint of physical chemistry, will be undertaken by several divisions.

BRIQUETTING DIVISION.

The briquetting division, which occupies the large room at the

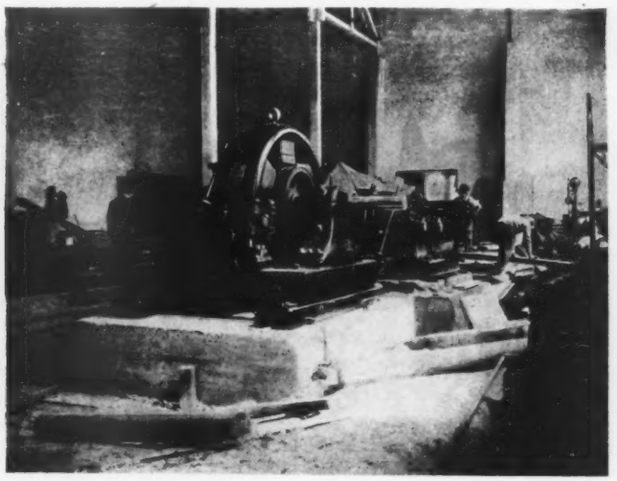


FIG. 5.—GENERATOR DRIVEN BY GAS ENGINE.

end of the building, is putting down one additional German briquetting machine, while the previous apparatus of English and American manufacture, that was used at St. Louis, is installed in the same room. The work of this division will be chiefly the manufacture of briquettes from various run-of-mine coals of the Eastern fields, which will be tested on war vessels under the direction of the steam engineering division.

OTHER PLANS.

The further fuel testing work of the Geological Survey includes tests dealing with the spontaneous combustion of the

FIG. 6.—GAS PRODUCER PLANT.

stored coals, in which an effort will be made to simplify the methods for its prevention; while a corps of specialists will be detailed to investigate closely the whole subject of explosions in coal mines with a view to eliminating danger from this source.

Electrically-Operated Water-Works of Tacoma, Wash.

By H. Cole Estep.

The encouragement, by central station companies, of the use of electric drive for the operation of small pumps is not new and the many companies that have entered this field have found it profitable. But central-station managers do not seem to be so strongly attracted to large pumping contracts and one finds in most cities of moderate size, even where there is a lively, progressive central station company, that the city water pumps —the biggest pumping load in the town—are operated by an isolated and usually wasteful steam plant.

Sometimes this condition exists because the central station could not get the load without going into politics and dealing on other than a strictly business basis; more often the possibilities of the city pumping load are overlooked. Sometimes with small stations themselves operated by steam, electric drive could not be furnished any cheaper than the direct steam-driven pumps are costing, but usually the central station company is in a position to offer rates at once profitable to itself and considerably below the city's cost of pumping. Where the electric plant is driven by water power and the pumping station by steam, as is true in a great many towns in the west, the central station can usually cut the city's pumping bill from 30 to 40 per cent and still receive a fair profit for its services.

Under these conditions city water pumping furnishes a very desirable load and offers business well worth going after. Where there is a reservoir the pumping can usually be done in the early morning and forenoon, shutting down when the evening peak begins to appear. The load is uniform, dependable and comes on and off at fixed times. Whenever the load can be distributed throughout the non-peak period as suggested above, provided the pumping plant is of any size, a rather startling improvement in the load factor will result.

The electric driven plant at the wells of the city of Tacoma, Wash., furnishes a concrete example of what may be done with a city pumping contract. The energy is furnished by the Snoqualmie Falls Power Company. At South Tacoma, now a part of the incorporated city, are located eleven semi-artesian wells all about 150 feet deep. The total head pumped against is about 160 feet, corresponding to a pressure of 70 pounds per

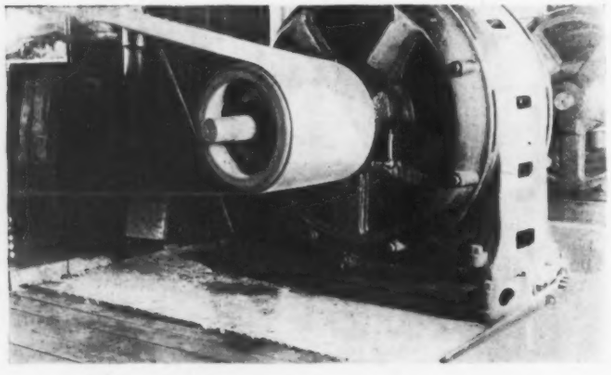


FIG. 1.—75-HP MOTOR DRIVING AIR COMPRESSOR.

square inch. On account of the topography of the city, the water is delivered into two distributing systems, the high level and the low level. The water for the low level system is delivered by the pumps into a flume situated at the station, through which it flows by gravity to the low-level reservoir. Two Gould pumps working against a head of 200 feet (90 pounds per square inch), pump the water directly into the mains of the high-level system.

The wells are from seven to twelve inches in diameter, and furnish from 90,000 to 600,000 gals. per 24 hours each, the whole set having a flow of about 5,000,000 gallons daily. The city council has recently appropriated $100,000 to sink a 1000-foot well and bring the capacity of the plant up to the demands made upon it.

The pumping is done by an air lift system, the motors operating the compressors. The air is led down through a pipe in the well casing, ending in a jet, the force of which pumps out the water. The total capacity of the station is 600 horse-power.

The machinery is owned and operated by the city; the power company merely furnishes the electricity. The present contract was made during a period of strenuous competition and the

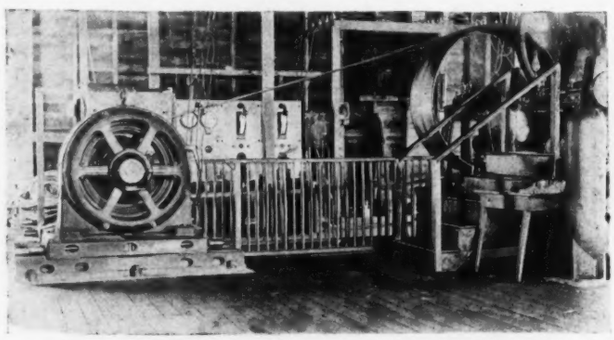


FIG. 2.—150-HP MOTOR DRIVING PUMP.

city gets its electricity at the absurdly low rate of three-tenths of a cent per kw-hour. The load was very desirable, however, and the company took it at the above figure with the understanding that at the expiration of the present contract, within a few months, the rate would be raised to the more reasonable figure of 1¼ cents per kw-hour.

Of course, the cost of maintenance and operation is considerably below that of an equivalent steam plant. One man on each shift operates the plant and has but little to do except to keep awake. A corresponding steam plant would require at least three men on each shift and a little over double the present wage expense. A steam plant would require three times as much oil and waste, to say nothing of repairs and miscellaneous expenses.

Another feature that makes the electric system attractive to the city is the ease with which the plant can be enlarged. Tacoma, like all Pacific Coast towns, is growing very rapidly, and the problem of increasing the capacity of the plant easily is an important matter. All that is necessary with the electric drive in use is to install a new transformer, motor and pump, bore a new well and connect the piping.

The present plant is housed in a frame building 100 by 40 feet in size. The air compressor equipment consists of one 150-hp, 2300-volt, 495 revolutions per minute, two-phase Westinghouse induction motor belted to a horizontal two-cylinder Ingersoll-Rand compressor; and two 75-hp, 2300-volt, 600-revolutions per minute, two-phase Westinghouse induction motors, each belted to a 75-hp. horizontal, two-cylinder Ingersoll-Sargent compressor. The 150-hp compressor unit is now being installed and, as the occasion demands, others like it will be added. The air is compressed to 210 pounds per square inch. For pumping into the high-level mains there are two 150-hp motors identical with the one belted to the large compressor, each belted to a vertical, triplex 12 by 14 inch, 42-r. p. m. Gould pump. Each of these pumps furnishes 2,000,000 gallons per 24 hours against a 200 foot head.

The switchboard has three panels on which are mounted the station instruments and motor controllers. Back of the board are two manually operated 2300-volt oil-switches. The transmission line brings in the current at 23,750 volts and it is stepped down to 2300 volts by four 180-kw, two-phase, four-wire General Electric transformers. Adjacent to the transformers are the 23,750-volt, air-brake switches. In order to protect the plant from fire the transformers are placed in a separate building forty feet from the main power house.

The city of Tacoma has in the above described installation a thoroughly efficient and satisfactory pumping station without which it could not furnish water at the prices it does. At the same time the power company has a highly desirable load paying, under the new rate, a reasonable profit and the arrangement is satisfactory to all concerned. Other central stations might investigate with profit the opportunity for making similar contracts, modified to meet local conditions, in their own cities.

The Synchroscope.

By S. R. Dodds.

Almost every engineer or switchboard attendant who has used alternating-current apparatus is familiar with the use of the synchroscope, but probably the fundamental principles on which it operates are not so well known.

The construction of one of the instruments in common use, the invention of Mr. P. M. Lincoln, and the method of connecting it are shown diagrammatically in Fig. 1.

It is essentially a small bipolar motor having on its armature two coils whose planes are at right angles to each other. These coils A and B are connected to the bus-bars, or to the generator leads, through slip rings on the armature shaft. In series with one coil is an inductive resistance and in series with the other a non-inductive resistance. This arrangement is used for producing two-phase currents in the armature from one phase of the bus-bars or generator leads, the currents in the coils A and B being nearly 90 degrees apart. The currents being displaced 90 degrees both electrically and mechanically, a rotating field of flux is set up around the armature. The stationary field winding is connected to one phase of the generator leads, or it may be connected to the bus-bars and the armature connected to the generator leads.

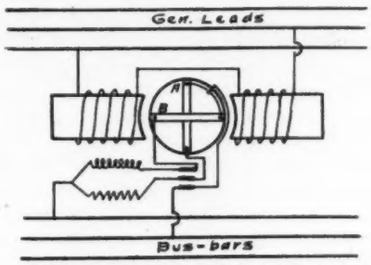


FIG. 1.—DIAGRAM OF CONSTRUCTION OF INSTRUMENT.

From the figure it will be seen that the armature will have a rotating field which is acted upon by the pulsating field of the field coils. The action of the instrument depends on the relation between these two fields.

A conception of the physical relations between the fields may be had from a consideration of Fig. 2.

Suppose the machines are in synchronism and that at a given instant the north pole of the revolving field has the position N,

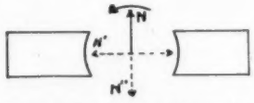


FIG. 2.—RELATION OF FIELDS.

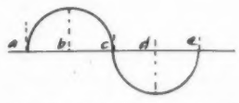


FIG. 3.—WAVE OF E. M. F.

shown by the full line, 90 degrees to the X axis, and revolving in a direction shown by the curved arrow. At the same instant let the pulsating field, the resultant of the sine wave of e. m. f., Fig. 3, be zero, and about to produce a north pole to the left. Since the pulsating field is zero no torque can be exerted on the armature at this instant. When N has turned through 90 degrees and is parallel to the X axis, the pulsating field will have reached its maximum value, point b on the sine wave, and since the fields are parallel and in the same direction, no torque will be produced in this position. When N has reached the position N^{II}, the pulsating field will again be zero, point c, and the torque will be zero. The same conditions will be repeated from N^{II} to N.

While N is passing to N^{I} torque will be exerted in the direction of the curved arrow, tending to pull N into the position N^{I}. While passing from N^{I} to N^{II} an equal pull in the opposite direction will be produced, the resultant torque for these two quadrants and for a complete period being zero.

If the machines are not in synchronism the torque will not be zero. Suppose that the rotating field is slow and that when the sine wave has reached the maximum point b, N has reached some point between N and N^{I}. The torque in this quadrant will now be greater than that between N^{I} and N^{II} and the armature will rotate in the direction of the curved arrow. If the rotating field is fast the torque will be in the opposite direction and the armature will rotate clockwise.

The conclusion reached above may also be shown analytically.

Let F represent the maximum value of the pulsating field.

Let F^{I} represent the resultant rotating field.

Let M represent the instantaneous torque between the two fields.

Let α represent the angle between the two fields.

Referring to Fig. 4, $F \sin \alpha$ will be the vertical component

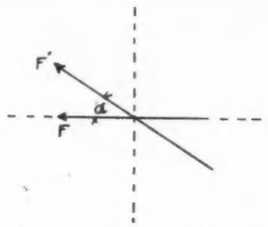


FIG. 4.—ANALYSIS OF ROTATING FIELD.

of the rotating field and the instantaneous torque M between the two fields will be:

$$M = K F F^{I} \sin \alpha \qquad (1)$$

Assume that the machines are in synchronism and that the pulsating field has a value of $F \sin \omega t$, then the frequency of F^{I} will also be $F^{I} \sin \omega t$.

If we assume F to be zero when $t = o$ then at a time t, when the pulsating field has the value F, the angle between the two fields will be $(\omega t + \alpha)$ and the expression for the instantaneous torque will be, substituting in (1)

$$M = K F \sin \omega t F^{I} \sin (\omega t + \alpha) \qquad (2)$$

Because of its inertia the armature cannot follow the rapid alternating impulses of the torque between the magnetic fields, but its rotation will be due to the average torque for a complete period. The average torque may be found by taking the sum of the instantaneous values of torque and dividing by the time of a complete period.

Let M_{ave} represent the average torque for a period,

Let T represent the time of a period,

then

$$M_{ave} = \frac{1}{T} \int_{0}^{2\pi} M \, \delta t \qquad (3)$$

Substituting in (3) the value of M given in (2) we have:

$$M_{ave} = \frac{1}{T} \int_{0}^{2\pi} K F \sin \omega t F^{I} \sin (\omega t + \alpha) \, \delta t \qquad (4)$$

Simplifying this equation we have:

$$M_{ave} = \frac{1}{T} K F F^{I} \cos \alpha \int_{0}^{2\pi} \sin^{2} \omega t \, \delta t \qquad (5)$$

Integrating this expression and substituting $\frac{2\pi}{T}$ for ω we obtain the result:

$$M_{ave} = \frac{1}{2} K F F^{I} \cos \alpha \qquad (6)$$

In order that the average torque, M_{ave}, may be zero for a complete period, when the machines are in synchronism, *cos* α of equation (6) must be zero, therefore α must be 90 degrees.

This shows that when F, which is parallel to the X axis, is zero F^1 must be 90 degrees to X. Under these conditions the resultant torque is zero and the armature remains stationary.

If α is less than 90 degrees *cos* α is negative and the armature will rotate in the same direction as the field. If α is greater than 90 degrees *cos* α is positive and the rotation of the armature will be opposite to that of the field.

In explaining the action of the split phase arrangement of the synchroscope the statement was made that the currents in the coils are displaced nearly 90 degrees. While it would be possible to produce such a condition, the phase displacement in the instrument as actually constructed is much less than 90 degrees and the rotating field is not uniform. The field is also distorted by the iron in the field poles. This irregularity of the field does not affect the final result as given above.

Recent Electrochemical Patents.

ELECTRIC FURNACES.

The large number of patents which have recently been granted for electric furnace processes and details of construction, emphasizes the great activity which marks just at present the introduction of the electric furnace into various fields of metallurgy.

In the field of ferro-alloys the Electro Metallurgical Company —a new company closely allied with the Union Carbide interests —has entered the field and has absorbed the pioneer ferro-alloy plant of this country, the works of the Wilson Aluminum Company. The latter company made chiefly ferro-chrome, but the new company will make a great variety of different ferro-alloys, as is indicated by a long series of patents recently granted to Mr. E. F. Price and Mr. Fred. M. Becket. Two patents of Mr. Price relate to the construction of arc furnaces for making ferro-silicon and silicospiegel; by providing a high column of charge above the real hearth and surrounding the electrodes, the heat is retained in the furnace and the electrodes are protected from the oxidizing and cooling effects of the atmosphere. In another construction of Mr. Price, the hearth or crucible at the bottom of the furnace is made detachable so that when it is filled with the desired product it is withdrawn and an empty crucible is substituted.

In several patents of Mr. Becket, chiefly relating to vanadium and its alloys, silicon is used as the reducing agent. Since the oxidation heat of silicon is very high and comparable with that of aluminum, silicon is a very strong reducing agent and it will be used to advantage in cases where the object is to produce a metal or alloy low in carbon. Vanadium may be reduced from vanadium sulphide in a single reaction by means of silicon. For the reduction of vanadium from the oxide, silicon and carbon, preferably in the form of carbon silicide, is a useful reducing agent. If vanadium is to be reduced from a higher oxide it is advantageous to divide the process into two steps; in the first step the higher oxide is reduced to a lower oxide with carbon in a gas furnace, and the lower oxide is later reduced with carbon silicide in an electric furnace. In this way the amount of carbon silicide required and the amount of electrical energy are reduced.

Even, however, if silicon or aluminum is used as a reducing agent in an electric furnace, carbon is liable to enter into the composition of the metal or alloy, this carbon coming from the electrodes. Since naturally the contamination by carbon will be higher the greater the contact surface between the electrodes and the charge, Mr. Becket recommends the use of electrodes of very small sectional area. Since they have to carry a strong current he cools them artificially by water circulation. Messrs. F. von Kügelen and G. O. Seward go a step further by employing water-cooled metallic electrodes for the same purpose. An alloy of Mr. Becket which is stated to be particularly adapted for the treatment of iron and steel contains titanium, calcium, aluminum and silicon and is produced by the reduction from the oxides with carbon in the electric furnace.

With respect to the manufacture of steel in the electric induction furnace it is interesting to note that Mr. E. A. Colby, of this country, the original inventor of the induction furnace, and Mr. F. A. Kjellin, the Swedish engineer, who was the first to make a commercial success of the induction furnace, have combined forces in this country, the American Electric Furnace Company being the result. Mr. Colby's fundamental patents have run out or are about to run out, but there are still many details left for working out, as is evidenced by the recent patent of Mr. Colby with no less than 36 claims. The primary is in the form of a copper-tube coil through which water is passed for cooling. Great attention is paid to proper insulation, ease of assembling the different parts of the furnace, etc.

Mr. J. Härdan wants to feed a single induction furnace with three-phase currents. A patent recently issued to him shows various arrangements in which stationary transformers are inserted between the polyphase line and the single-phase induction furnace. In view of the well-known fact that it is impossible to convert balanced polyphase current into single-phase without the aid of rotary machinery, it is clear that in Mr. Härden's arrangements the polyphase system must become unbalanced.

A simple improvement patented by Dr. Paul Héroult is interesting from an electrical engineering point of view. It relates to furnaces with one electrode suspended from above, the carbon crucible forming the other electrode. The body of the furnace is made of carbon and is bound or surrounded by jackets of rings of iron, steel, etc. As is well known, this gives a strong mechanical structure, but if the iron jacket is continuous all around the periphery, it has the great disadvantage that a magnetic flux is set up in this ring with self-evident results. By substituting copper or other non-magnetic material for the iron at some point in the ring, it is possible to reduce very largely the impedance of the furnace when operated with alternating currents.

New Telephone Patents.

A few weeks since we noted an improved transmitter for telephone apparatus for the deaf, invented by W. H. Holland. Further improvements have now been patented by this same inventor in conjunction with G. W. Kauser, of Chicago. This transmitter is of same general form, but a membraneous diaphragm is used. An auxiliary diaphragm having a ring secured to its edge is pressed against the main diaphragm. This covers the major portion of the main diaphragm and helps to stretch it. The auxiliary diaphragm acts upon the microphone button.

A combined telephone and telegraph set for field use has been invented and patented by F. W. Medhurst, of Hobart, Australia. The whole apparatus is mounted in a leather carrying case, holding transmitter, receiver, switch, battery, telegraph key and reed sounder.

C. A. Anderson, of Lindsboro, Kan., has patented a step-by-step party line lock out and calling apparatus. The call is originated by a signal to the exchange operator, who then connects up both calling and called parties by means of their respective mechanisms.

For use on shipboard, a water tight switchboard is advisable and F. W. Wood, of Newport News, Va., has designed one with this in view. The switching is done by keys arranged in a bank. All keys in any vertical row are connected to one line, while all keys in any horizontal row are connected together. Two keys of a horizontal row similarly thrown connect therefore the two lines together which correspond to the vertical rows which include them. The key springs are mounted in a metal box, while the cams are mounted in a hinged false bottom, so that the springs may be quickly brought into view. A watertight cover seals the box when not in use.

LETTER TO THE EDITORS.

Fatal Contact Through Tape Measure.

To the Editors of Electrical World:

SIRS:—In regard to the note on page 276 in your issue for Aug. 10, in connection with the death of George Wesener, telephone lineman, by current transmitted through a cotton or linen tape drawn across a high voltage circuit, I would state that I remember distinctly a similar case near Stillwater, Minn., in which both the lineman and his ground man were killed by the measuring tape, apparently all linen, making contact with high-tension wires. I had the opportunity to examine the tape personally, after the accident, and while an external examination revealed no metallic parts the fact did not satisfy me. Upon cutting into the tape, I found that it was strengthened by means of fine flexible wires running lengthwise through it. Since that time, I have examined a number of tapes, such as are used by linemen, etc., and found that practically all of them are similarly reinforced.

While your article says there was no metal on the tape, it is quite likely that the tape was of a make similar to the above. It would be a good plan for all companies that are liable to use tape lines in the vicinity of high-tension wires, to examine the tapes, and make sure that there are no reinforcing wires inside of them, thus avoiding the possibility of placing lives in jeopardy.

NEW YORK CITY. M. A. MYERS.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Star-Delta Combination.—L. LEGROS.—A mathematical article on the use of the star-delta combination shown in Fig. 1 for three-phase machines. This method is found useful, for instance, when a machine has been wound and it is desired to get a greater saturation of the magnetic circuit for the given voltage in order to reduce the voltage drop. Another case where the method may be applied is when it is intended to raise or lower the normal voltage after the machine has been in operation for a certain time. In the diagram it is assumed that the machine was originally connected in star *OA, OB, OC* representing the three phases. The length of the three vectors is proportional to the number *P* of the coils per phase, all the

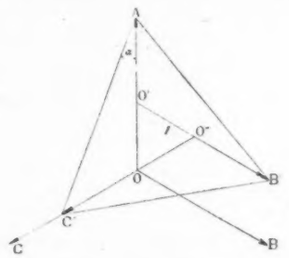


FIG. 1.—VOLTAGES IN STAR-DELTA COMBINATION.

coils having the same number of turns. Each coil corresponds to one pair of poles. In order to change the machine to the combination system, the end *O* of the phase *OB* is connected with the point *O'* of the phase *OA*, and the end *O* of the phase *OC* with the point *O''* of the phase *OB* so that in the vector diagram *OB* becomes *O'B'* and *OC* becomes *O''C'*. The end *O* of the phase *OA* is connected to the point *O* of the phase *O''C'*. There are *p* coils in each phase in star connection and the *P—p* coils form the triangle *O O' O''*. The system remains symmetrical. The author gives several simple formulas which are useful for this change.—*L'Eclairage Electrique*, July 13.

Compounded Alternators with Commutators.—A. HEYLAND.—A description of a number of practical experiences with some large compounded alternators with commutators which have been running for several years. The same article, printed in a German paper, has already been noticed in the Digest.—Lond. *Elec.*, July 19.

Compensated Single-Phase Shunt Motor.—J. BETHENOD.—A further article in his series of notes on this subject. In the present installment he gives an approximate graphical solution of the problem.—*L'Ecl. Elec.*, July 20.

Lamps and Lighting.

Illumination of Side Streets.—An editorial discussion. In side streets the subdivision of sources of illumination into smaller units is essential since the capital outlay and yearly cost must be low, and if arc lamps are placed a considerable distance apart a very spotty effect is produced. For this reason incandescent gas has been frequently adopted for illumination of side streets. Carbon incandescent lamps are unsatisfactory on account of their low efficiency, while metallic filaments appear to offer the best solution of the problem. In addition to the efficiency being high, there is the further advantage over incandescent gas that the metallic filament lamp retains its candle-power much more constant than does an incandescent mantle. Some figures given by McCourt are mentioned. Considering an osram lamp which gave 54.5 candle-power and 54 candle-power, respectively in two consecutive months, and taking the osram lamp at 52 watts, with electrical energy supplied at 6 cents per kw-hour and gas supplied at 70 cents per 1000 cu. ft., as charged at Harrogate, he found that there was a saving in favor of electricity of 17.6 per cent. Considering that 6 cents per unit is a high price for street lighting, it will be seen that the advantage of the metallic-filament lamp over gas should be very considerable. The use of a number of low-voltage lamps in series is not disadvantageous in street lighting, but it is necessary that all lamps run in series be practically identical.—Lon. *Elec.*, July 26.

Street Illumination.—K. EDGCUMBE.—A letter in reply to criticisms of H. T. Harrison. The minimum illumination should be kept high, but this is not sufficient. The mean illumination is very important. He makes some correctons in his table of

Tantalum in Reason-Harrison fitting	1.0
Osram in Reason fitting	1.2
Bastian mercury-vapor	1.55
Tantalum in Loftus lantern	1.8
Low-pressure gas burner	2.1
Nernst lamp in holophane globe	2.5
Keith high-pressure gas	2.5
Three-burner high-pressure gas	2.9

the relative cost of electric lighting and gas lighting. His corrected table is given herewith.—Lond. *Elec. Eng'ing*, July 18.

Nernst Lamp.—A note on an improvement made by the maker of Nernst lamps for Great Britain, the Allgem. Elek. Ges., English Manufacturing Company. "The current taken by the heating coil of a Nernst lamp is approximately 60 per cent of the current taken by the burner itself. If the cut-out coil is defective in insulation, the heating coil will remain in parallel with the filament. Not only does this affect the efficiency of the lamp, but, as the resistance of the filament decreases with the increase of temperature which results when the heater and the filament are in circuit at the same time, the burner is over-run and burns out. The maker states that the life of a Nernst burner when the insulation of the cut-out is defective may be as low as 20 hours, and when the cut-out coil has entirely burnt out, a burner may last for only an hour or two. The average life of the heating coil when in circuit is only 20 hours, and the average time required to heat the filament is said to be one minute. Thus, the heater should allow the lamp to be switched on and off about 1200 times if there is no defect in the cut-out coil. The maker announces that all

lamps supplied hereafter will be fitted with a cut-out coil of new design and high insulation resistance and old bodies will be fitted with the improved coil, free of charge."—Lond. *Elec. Eng'ing,* July 18.

Metallic-Filament Lamps.—An article illustrating "adapters" for coupling metallic filament lamps in series using ordinary sockets. On alternating-current systems the voltage may be reduced in an inexpensive manner by the use of small transformers. An auto-transformer, similar to those employed for supplying alternating-current arc lamps, can be used, in which the internal losses are so low that a large net saving in consumption can be shown. For example, with the best grade of magnetic iron now obtainable three-wire auto-coils have been constructed capable of dealing with an out-of-balance current of three amperes, and in which the losses do not exceed 3.5 watts. Some figures are given showing that such a method would be quite economical.—Lon. *Elec. Rev.,* July 19.

Power.

Test of a 3000-kw Turbine.—An account of a test on a steam turbine which took place at the electricity works in Moabit, Berlin. At full load (3115 kilowatts), with steam at a pressure of 12.1 atmospheres, and at a temperature of 309 degs. C., and with the turbine running at 1500 r. p. m., the steam consumption was 12.95 lbs. per kw-hour, not including that used for the condenser, but including the excitation. The amount used for condensation purposes was 73 horse-power at full load.—From *Zeit. f. d. ges. Turbinenwesen;* abstracted in Lon. *Elec.,* July 26.

Refuse Destructors.—G. Dettmar.—The conclusion of his long article in which he endeavors to show that the problem of refuse destruction is a very important one in hygienic as well as commercial respects. The best solution, in the author's opinion, is to use the heat which is thereby rendered available for the generation of electrical energy in combination with electric supply stations. He also recommends the combining of a bath house or a laundry with the plant, in order to use the heat from the refuse destructor at times when the electric station is not fully loaded.—*Elek. Zeit.,* July 18.

High-Tension Direct-Current Power Transmission.—An abstract of an article in *Elek. und Masch.,* recently noticed in the Digest, in which Highfield's paper on the Thury high-tension direct-current system of electric power transmission was discussed and criticised.—Lond.*Elec.,* July 26.

Winding Plant in a Mine.—An illustrated description of the electric winding plant at Ligny-les-Aire. A Koepe pulley is used, mounted with its motors, on a steel tower immediately over the shaft. Continuous-current motors are used, supplied with a varying voltage, controlled by alterations of the excitation of a motor-generator. A flywheel is used to keep the input to the motor-generator set practically constant.—Lond. *Elec. Eng'ing,* July 18.

Mauritius.—G. McAlpine.—An illustrated article on electrical development in Mauritius, a little island in the Indian Ocean. The staple industry is cane sugar, and electric power is entering this field. It is also intended to electrify the steam railways, since the cost of steam power in Mauritius is very high. Most of the electrical energy used at present is derived from water power.—Lond. *Elec. Eng'ing,* July 18.

Traction.

Surface Contact System in London.—On a certain line in London the "G. B." surface contact system will be used to replace horse traction. The overhead trolley system is not permitted by the city authorities, while the conduit system is believed to be too expensive. The G. B. system has been in use in Lincoln for 18 months, "and this line has been remarkably free from the troubles that have been met with on many of the competing systems." It is stated that "the cost of the G. B. surface contact system, under normal conditions, per mile of single track (exclusive of cables and equipment common to both systems) is estimated at $52,500, as against $85,000 for the conduit system, and this saving justifies the committee in recommending that it should be given a trial between Adgate and Bow. It must not be forgotten, however, that the cost is still much higher than that of the overhead trolley system. Alhough the cost of the latter may only be $5,000 per mile less than the expenditure which would be incurred in laying down the surface contact system, it must be remembered that in comparing double-track lines the saving is more marked."—Lond. *Elec. Eng'ing,* July 18.

G. B. Surface Contact System.—There are two classes of surface-contact system. In the first class, of which the Schuckert system is an example, the switches through which the surface studs are made alive are assembled in groups, which are placed in pillars or street boxes and connected by cables to the separate studs. The method by which the feeding cable is connected successively to the studs in step with the movements of a car are quite different in the different systems, but in each the switch movement is brought about by a current from the car skate when it first touches a stud. The current energizes a magnet, which moves a switch connecting the stud to the main, and at the same time disconnects a stud in the rear of the skate. The second class of design includes a switch movement in the stud block, the switch being moved to the live position by the pull of a "pick-up" magnet carried on the car, or by an electromagnet in the stud energized by the first contact of the skate. The G. B. system, which is to be used in London as an experiment on a certain line, belongs to the second class, and has a very cheap and simple construction. "The main conductor is a galvanized-iron, stranded cable drawn into a stoneware pipe and carried on reel insulators, supported by iron spindles crossing the pipe. As there are no joints or attachments made to this conductor at the studs, it can be drawn out for renewal or examination from suitable access boxes. The insulator spindles project through the pipe, and are attached to an earth wire or strip, bonded to the rails. As any surface leakage from the conductor, whether at or between studs, must get to the insulator spindles, this simple device constitutes a continuous 'guard ring' which appears to make the charging of a stud by leakage impossible, except in the event of a switch chamber being filled with mud or water. The switch-movement mechanism is fitted into a vertical branch pipe, jointed into a socket in the conduit pipe. It consists of a rectangular stem of laminated iron, carrying at its end a small block suspended in a recess by a coiled spring. This suspended block is armed with a carbon contact piece, and hangs over the iron conductor. The laminated stem is bolted above to a T-shaped stud, of which the top surface is nearly flush with the paving, let into a block of granite, which forms part of the paving, and the stem is luted into the vertical branch pipe with pitch. When the magnetized skate rubs the stud, the magnetic flux, passing down the laminated stem into the iron cable, causes the suspended iron and its contact block to move downwards, until contact is established and the stud is alive.—Lond. *Elec. Eng'ing,* July 25.

Installations, Systems and Appliances.

Effect of Metallic Filament Lamps on Central Station Output.—The Brighton municipal station had a loss of $5,000 last year which has increased this year to over $50,000. This is to some extent due to the introduction of a flat rate, which can be selected, instead of the maximum-demand system and which is sufficiently low (8 cents per kw-hour) to tempt unremunerative consumers from the maximum-demand tariff. The number of kw-hours sold has somewhat decreased, and the number of kw-hours sold per 8-cp lamp connected has fallen considerably below the figure of the last two years. This is attributed to the use of high-efficiency metallic-filament lamps. At Dudley the increase in income from private consumers is also said to be smaller than would otherwise have been expected. While this is attributed to the metallic-filament lamp, the engineer in charge of the station thinks that the new lamps should be cultivated, and it is suggested that it may be necessary when laying mains in new streets to put in a five-wire system with local balancers in place of a three-wire system, so that houses may be supplied at half the present pressure. In an editorial note

it is doubted whether this system would be advantageous since the addition of such a network with balancers necessarily adds considerably to the cost, and defeats the entire object of the double pressure supply which is now almost universally adopted in England.—Lond. *Elec.*, July 19.

Time-Lag Relays.—An illustrated description of some recent forms of time-lag relays of Statter. The general principle of their action is seen from the left-hand diagram of Fig. 2, which

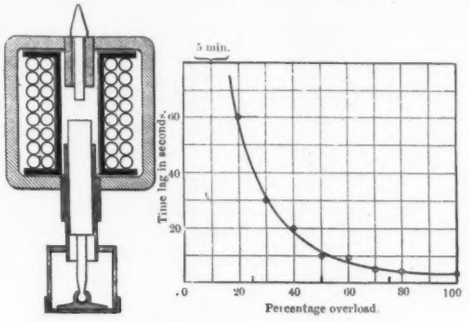


FIG. 2.—TIME-LAG RELAY.

gives a section of the apparatus. The disk is lubricated with glycerine, which adheres to the bottom of the case, and delays the action of the apparatus for a certain time, depending on the strength of the pull of the solenoid upon the core. The apparatus is set to come into action at any desired overload by raising or lowering the pot containing the sucker disk, which is attached to the tube surrounding the core. A screw adjustment is provided, and a scale is marked on the outside of the tube showing the current at which the appliance will ultimately break circuit if applied for a sufficiently long time. A typical example showing the variation of the time lag with different overloads is given in the right-hand diagram. The arrangement of connections for applying the device to an ordinary motor-starter, with "no-voltage" release, is shown in Fig. 3.

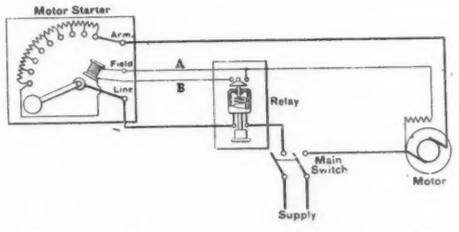


FIG. 3.—RELAY APPLIED TO ORDINARY STARTER.

The relay is arranged to act on the no-load magnet of a starter, and the connections are merely electrical ones which can be made quickly by any competent wireman. The action of this relay in short-circuiting the no-load coil is positive and definite and does away with the usual overload arrangement as applied to starters. Another form of relay is made for coupling to the trip-coils of circuit breakers or oil switches for alternating-current work in a way similar to the arrangement of induction relays.—Lond. *Elec. Eng'ing*, July 18.

Electrical Accidents.—G. S. RAM.—His report, as electrical inspector of factories on accidents which have arisen from electrical causes. Many cases of burns have been reported due to flimsy main switches used in conjunction with starting switches of inferior construction. The starting switch fails to move back automatically when the main switch is turned off, and the resultant arc, when the main switch is put on again, flashes through the slot provided for the handle. Main switches in which the handle is attached to a bar of insulating material fixed between the two blades by metal studs, with projecting heads, are described as a "particularly dangerous type," although a "universal favorite," and the author expresses his preference for those enclosed switches in which the handle is attached to an extension of the spindle and no slot is needed in the cover. Several cases of severe burns from short-circuits in connection with portable appliances are reported, and also some due to the use of exposed fuse wires. Among the fatalities is one from a shock received by an arc-lamp trimmer through the imperfect action of a double-pole switch, in which one blade remained making contact when the handle had been turned off, one due to contact with a bare joint on temporary work at 200 volts, two from contact with unprotected live terminals, and one from a shock received from the pedestal of a defective desk fan. The author raises the questions whether all metal parts on portable appliances should not be definitely connected to earth, and whether it should be permissible for one man to work alone in large sub-stations, with moving machinery.—Lond. *Elec. Eng'ing*, July 18.

Electrophysics and Magnetism.

Tantalum.—M. VON PIRANI.—An account of measurements which show that the specific resistance of pure tantalum is 0.146 and the temperature coefficient between 0 deg. C. and 100 degs. is 0.33.—Lond. *Elec.*, July 26.

Vacuum Tubes.—A. A. C. SWINTON.—A Royal Society paper on the occlusion of the residual gas by the glass walls of vacuum tubes. The result is that the vacuum increases in the tube.—Lond. *Elec.*, July 26.

Electrochemistry and Batteries.

Electric Smelting of Iron Ore.—R. L. PHELPS.—An account of the latest developments at the electric iron smelting plant at Heroult-on-the-Pitt in California, where magnetite ore, available there in large quantities, is to be reduced in the electric furnace. The energy is obtained from a California transmission company using the three-phase system. By means of transformers the 22,000 volt, 60-cycle, three-phase currents of the transmission line are changed into 50 volts, 30,000 amperes, three-phase currents and are thus delivered to the electric furnace. The latter has three electrodes suspended from the top, while the neutral point is in the bottom of the furnace. The charge is made of charcoal, limestone and ore. The charcoal is made in kilns close to the plant, unlimited supply of timber being available.—*Mining and Scientific Press*, July 20; *Electrochem. and Met. Ind.*, August.

Electrolytic Refining of Tin.—O. STEINER.—An illustrated description of the Claus process of electrolytically refining tin which is in commercial use in a plant in England. The raw tin anodes are used in a 10 per cent sodium sulphide solution at a temperature of 90 degs. C., with a current density of one-half ampere per square decimeter electrode surface at a voltage between 0.1 and 0.18 volt. The tin is deposited on the cathode in pure solid condition, while the foreign metals are precipitated as sulphides and form the anode slimes mostly attached to the anode, but partly accumulating on the bottom of the tank. The precautions which must be taken in the use of the process are described in detail.—*Electrochem. and Met. Ind.*, August.

Chlorates.—G. ROSSET.—The first part of a serial on the electrolytic production of alkaline chlorates.—*L'Ecl. Electrique*, July 27.

Units, Measurements and Instruments.

Indicating the Level of Water at a Distance.—A description of an instrument devised by Rittmeyer for indicating the level of water in a reservoir, etc., at a distance. The arrangement is shown in Fig. 4. A float on the water actuates a sliding contact K (in the left-hand part of the diagram) so as to make connection with the rheostat W. The terminals of the latter are connected through two transmission lines R with the two coils of a differential galvanometer D connected to the receiving instrument, which contains a rheostat of the same resistance W as at the other end. But at the receiving end the contact device K is moved along by hand. At this end K is connected through the battery B to earth. The galvanometer will show no deflection if the two currents J_1 and J_2 are equal, and this will be the case if the contact devices K make contact with the same notch at the receiving end and at the transmitting end. It is, therefore, only necessary to move the contact device along the

rheostat at the receiving end until the galvanometer showns no deflection. Then the height of the water at the other end is directly found. It is, of course, possible to let the needle of the galvanometer act on a relay which automatically moves the contact K at the receiving end until no current flows in the

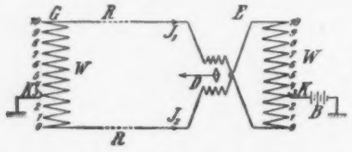


FIG. 4.—CONNECTIONS OF EQUIPMENT FOR INDICATING THE HEIGHT OF WATER AT A DISTANCE.

galvanometer. In this case the position of K at the receiving end shows directly the height of the water in the reservoir at the transmitting end.—*Schweiz. Elek. Zeit.*, Vol. 3, 1907, p. 635; *Elek. Zeit.*, July 18.

Measuring Resistances with a Telephone and with Direct Current.—G. Athanasiadis.—A description of a plan for applying the telephone method devised by Kohlrausch and Nernst to the measurement of resistances and capacities even without alternating currents. Direct, but undulatory currents from a central station will suffice. Sent through a telephone and suitable resistance, they give a pure note, whose frequency is equal to the number of commutator bars passing under the brushes per second. Such a note may also be produced by inserting a condenser of high capacity or a condenser and telephone. The substitution of direct for alternating currents is claimed to accelerate the measurements, simplify the apparatus and economize the consumption of electricity. The author describes in detail the measurement of a non-inductive resistance, of an electrolytic resistance, and of the capacity of a condenser. The condenser is used only for the last two measurements. The reading is taken with a Wheatstone bridge arrangement, the pointer being located either where the telephone becomes silent or midway between two positions where it is just audible. The limit of error is one-tenth per cent.—From *Ann. der Phys.*, No. 7; abstrated in Lond. *Elec. Eng'ing*, July 18.

String Galvanometer for Alternating Currents.—G. Zemplen.—Einthoven's string galvanometer has made its way as a useful instrument for studying direct currents, especially since Salomonson substituted field wires for field magnets and used this electrodynamic instrument as an electrometer and a wattmeter. The present author tried to apply it to alternating currents, but found that as soon as alternating current was used, the black string on the bright background disappeared from view. He states, however, that when the background is dark and the string is illuminated in a direction making a small angle with the optic axis of the micrometer microscope, the instrument becomes available for alternating current. Then, when alternating current is applied, the bright string broadens out into a bright band with sharply defined edges, whose position can be read on the scale to within a tenth of a division. The background must not be entirely black, as otherwise the micrometer scale would disappear. The author has obtained a width of two scale divisions from a current of a millionth of an ampere. For the same frequency, the width of the band is an accurate measure of the current strength, but the scale must be calibrated separately for each frequency. The instrument is specially adapted to the comparison of telephone currents.—From *Phys. Zeit.*, July 1; abstracted in Lond. *Elec. Eng'ing*, July 18.

Starting Current Ammeter.—The recent rules of the German Association of Electrical Engineers require that the starting current of a motor should not exceed a definite limit depending on the output. But owing to the fact that the initial value of the current is only momentary, the first swing of an ammeter will not measure it correctly, as the amplitude of the swing depends on the amount of damping. An instrument designed to overcome this difficulty has lately been put on the market. It is provided with a movable arm, and by means of this the pointer may be carried round to any desired part of the scale. The pointer will then move only when the current exceeds the value corresponding to the position in which it has been placed. The position in which the pointer just moves when the circuit is closed is found by trial.—Lond. *Elec.*, July 26.

Three-Phase Meter.—An official communication by the German Reichsanstalt admitting a certain three-phase meter of the Siemens-Shuckert Company for calibration. It consists of two induction motors, the armatures of which are on the same axle, with a magnetic brake for each armature and with a common counting device.—*Elek. Zeit.*, July 18.

Telegraphy, Telephony and Signals.

Influence of High-Tension Lines on Telegraph Lines.—F. Schrottke.—The conclusion of his long paper in which the author attempts to calculate numerically the electrostatic induction of high-tension transmission lines on telephone lines in the neighborhood. His theoretical explanations are illustrated by numerous examples and some notes are also given on the problem of preventing electrostatic induction. In the appendix a collection of formulas is given for finding the "partial capacities" of conductors which are required for the calculation of the induction.—*Elek. Zeit.*, July 18.

Miscellaneous.

Electric Cooking.—An illustrated account of two heating and cooking installations in Switzerland of considerable size. At the Hotel Moserboden a load of 93.4 kilowatts results from the requirements of the kitchen, laundry and hot-water plant alone, irrespective of the power required for heating the hotel. At the Eismeer station on the Jungfrau the whole of the cooking is effected electrically by energy taken from the railway. Details are given of the apparatus in use and diagrams show the construction of water heaters, drawing-room stoves, baking ovens and ovens adapted for combining electric and coal heating.—Lond. *Elec.*, July 19.

Burner for Cutting Metals.—M. U. Schoop.—An illustrated description of a burner for cutting metal sheets, which consists of an ordinary oxygen-acetylene, oxygen-illuminating gas or oxygen-hydrogen burner, such as used for autogenous welding of metals, but provided with an additional small tube for separately supplying oxygen gas for cutting. First the oxygen supply is closed and by means of the simple heating burner the metal to be cut is heated to white heat along the line where it is to be cut afterwards. The oxygen supply is then turned on and the current directed against the metal along the cutting line. Under the action of the oxygen the autogenous burning of the iron starts immediately and the sheets are cut into pieces with sharp edges.—*Electrochem. and Met. Ind.*, August.

BOOK REVIEW.

La Telegraphie Sans Fils. Par E. Monnier. Preface de E. Branly. Paris: H. Dunod et E. Pinat. 142 pages, illustrated. Price, 2 francs.

As the title implies, this little volume is written for the purpose of popularizing the subject of wireless telegraphy. Hence the simple elementary details which are given of a primary battery, a Ruhmkorff coil, a Hertzian oscillator and Branly coherer. These are followed by a brief description of the relay, antenna and other necessary parts of a wireless outfit.

Under the heading of telemechanics, reference is made to the control of various mechanisms and devices from a distance by means of electric waves. Such instances are given as the starting of ventilating machinery, the blowing up of submerged mines, and the direction of torpedoes. Details of how all this can be done are not given.

This little work can be read with interest and advantage by the non-technical reader.

Compact Resistance Unit.

The resistance unit illustrated herewith consists of a single layer of high-grade resistance wire embedded in Di-el-ite, a material having the same strength and mechanical qualities as good bluestone. When desired, the unit can be made ironclad,

COMPACT RESISTANCE UNIT.

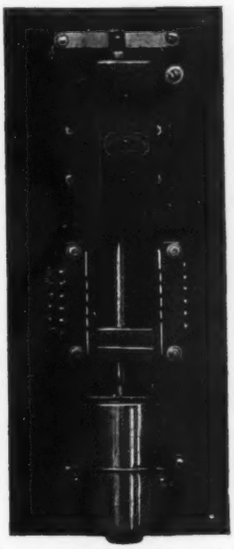


FIG. 1.—AUTOMATIC MOTOR STARTER.

in which form it will withstand a considerable amount of mechanical abuse. For intermittent work the large specific heat of Di-el-ite permits of a high rate of work, while for continuous service the resistance unit produces excellent results. Units of the above type are built for resistances varying from 1 to 10,000 ohms. They are manufactured by Charles Wirt & Company, Philadelphia, Pa.

Self-Starter for Motor Service.

Herewith is illustrated, Figs. 1, 2 and 3, a simple form of self-starter manufactured by the Ward Leonard Electric Company, of Bronxville, N. Y., together with wiring diagrams

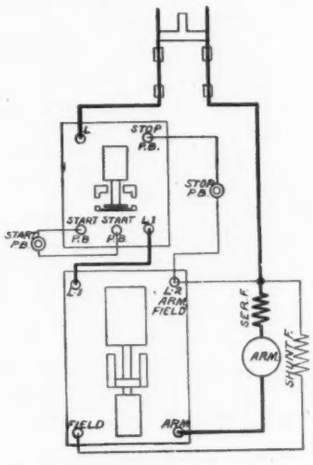


FIG. 2.—MOTOR STARTER USED WITH A SELF-CLOSING SWITCH.

for same. The diagram, Fig. 2, shows the self-starter in use with a self-closing switch, and Fig. 3 shows it with a Ward Leonard float switch. The self-starter is equipped with a no-voltage release protective device. The resistance is in the form of enamelled resistance units of the enclosed ventilated type, readily removable. It is simply necessary to close a switch and the device will automatically start any kind of direct current motor of its rated horse-power and voltage with which it is used. This fact is an important one, for it makes the starter universal and assists the purchaser as it is only necessary to state the line voltage and the horse-power of the motor.

A self-starter of this character is an economical device in more ways than one, as it takes the starting operation out of the hands of unskilled men, leaving it merely necessary to push a button or close a switch.

Steel Reels and Spools for Wire and Cable.

For years it has been the practice to ship wire and cable on heavy wooden reels, while the smaller sizes of wire are wound on wooden spools. Not only is this still true of shipping, but

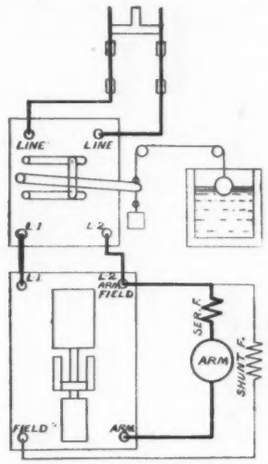


FIG. 3.—MOTOR STARTER USED WITH A TANK SWITCH.

also in the handling and rehandling of wire for various purposes. The cumbersome wooden reel is an easy prey for rough usage and naturally necessitates much repair work in order to be kept fit for service. The Frank Mossberg Company, of Attleboro, Mass., has brought out a line of patented pressed steel reels and spools to take the place of the wooden devices now in use. The reels and spools are made with diameters of

PRESSED STEEL REEL.

flanges varying from 2⅛ ins. to 48 ins. and combine strength with moderate weight. Twenty-five different varieties of reels are made and special sizes are procurable to meet certain requirements. The steel reel is much more economical and serviceable than the old style wooden arrangement it is designed to supplant and may be used in connection with handling wire for braiding and twisting machines, vulcanizing wire, winding magnet and fuse wire, shipping wire and cable.

Flush Push Button Switch and Wall Cases.

The accompanying illustrations show respectively an iron conduit box, a single wall case with knock-out holes, a two-gang wall case, and a shallow push button switch in wall case, brought out by the Machen & Mayer Electrical Manufacturing Company, of Philadelphia, Pa. The wall cases are made of sheet steel and are two inches deep. They are provided with four knock-out plugs, two in each end. The plugs are locked in position in such a manner that any one of them can be readily knocked out by a blow from a hammer without interfering with the others. The company also makes an extra unit by means of which gang boxes can be readily made by fastening the units together with one single box and steel strips furnished for the purpose. This enables the contractor to carry a stock of single boxes and units which may be made into gang boxes as required. The wall cases while only two inches deep allow as much space for wiring with the company's shallowest flush push button switches or its receptacles as a box one inch deeper will allow with switches of other makes.

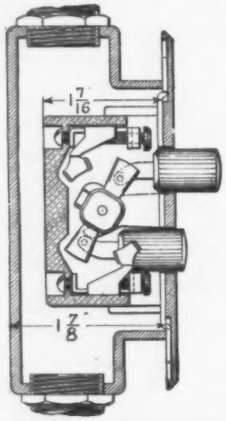


FIG. 1.—IRON CONDUIT SWITCH BOX.

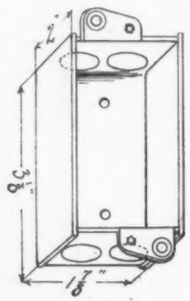


FIG. 2.—WALL CASE.

The conduit boxes are made for from one to ten gangs and are two inches deep. They are designed to allow ample room for wiring the company's switches and receptacles and are provided with knock-out plugs of the same character as the wall cases.

The company's shallowest flush push button switch will fit any standard box, giving an inch more space for wiring in the box than any other switch on the market. This is an advantage especially where there are splices in the wires or a cable running into a box when it has been found impossible to install the ordinary switch without the use of a wood mat in some cases.

Manufacture of Dynamo-Electric Machinery at Sandusky, Ohio.

The Warren Electric Manufacturing Company, as a result of costly and unfortunate experiments with a new type of steam turbine, which it proposed to introduce, went into the hands of receivers in October, 1905, and in March, 1907, its business was sold out by order of the court, at public sale to the highest bidder. The purchaser was the Warren Electric Manufacturing Company, of Sandusky, Ohio, a new corporation formed with $175,000 capital, all paid in.

As a result of these events and changes, the new company not only has an excellent shop equipment, but plenty of working capital. Not satisfied, however, with its plant as acquired, it has already installed a number of modern machine tools, and is to add still further to its facilities in this respect. A view is shown herewith of the present interior of the shop, where several large alternators are under construction.

The old company made only alternators of the inductor type, and in comparatively small sizes, whereas the present company manufactures both inductor and revolving-field alternators up to 750 kw. Some such machines are now under construction. The company is also about to put on the market a full line of alternating and direct-current motors, which will embody some novel features and will be described later.

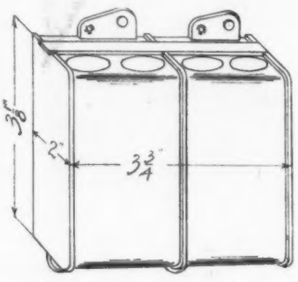


FIG. 3.—GANG WALL CASE.

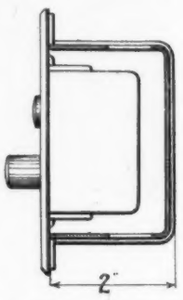
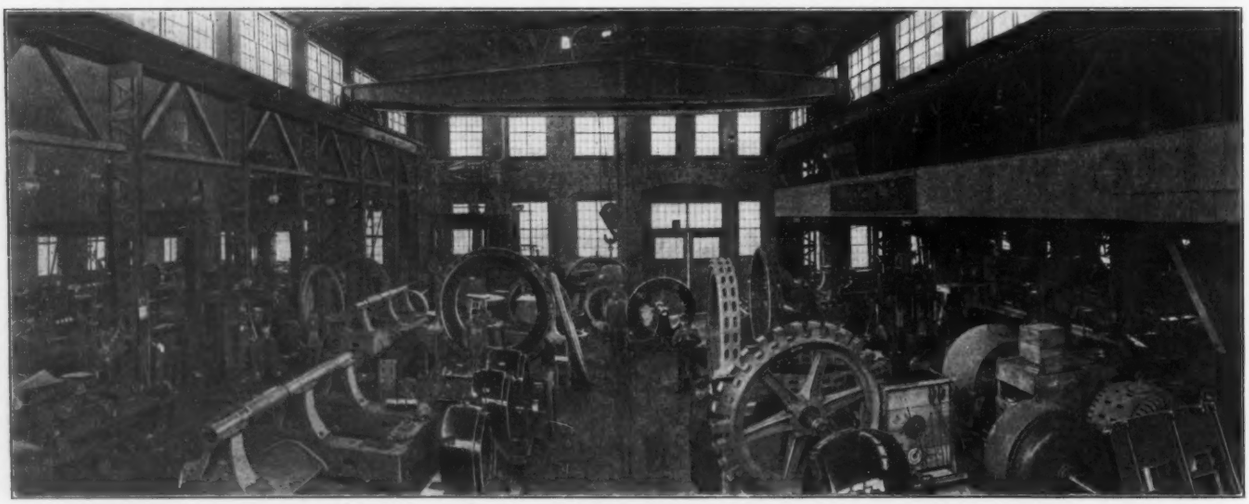


FIG. 4.—FLUSH PUSH-BUTTON SWITCH.

The president of the Warren Electric Manufacturing Company is Willard H. Nason, who is also vice-president of the Brilliant Electric Company, and is well known in the electrical field. Mr. Norman L. Hayden, the vice-president and general manager, was for ten years president of the Hayden & Derby Manufacturing Company, of New York, and founder also of the N. L. Hayden Manufacturing Company, of Columbus, Ohio, in which he is still a very large stockholder. Mr. Frank Warren, the secretary, was for years sales manager of the old company and is widely acquainted in this department of electrical industry.



SANDUSKY, OHIO, FACTORY OF THE WARREN ELECTRIC MANUFACTURING COMPANY.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Jobbing trade in fall and winter goods was active at the leading cities, country merchants being in large attendance and operating freely as a rule. Retail sales of seasonable merchandise were liberal, although at some points customary midsummer quiet is noted. While payments are somewhat irregular, mercantile collections show distinct improvement on the whole. A few labor disputes are pending, but there is little interruption in the leading industries, most manufacturing plants working full time and holding orders that promise continued activity. Commodity prices are lower, especially in cases where speculative inflation existed, favorable weather having greatly improved crop prospects. Railway earnings for July, complete for four weeks, show a gain of 9.3 per cent over the same month last year, and foreign commerce at the port of New York indicated an increase of $4,582,514 in value of imports as compared with a year ago. Ideal weather is reported for corn, except in parts of the Southwest; advices from the spring wheat section are better than for some time, and the hot weather benefits cotton. Winter wheat yields are also better than were earlier indicated, but oats are turning out short and light. In the Southwest, Northwest and at large Eastern centers, sentiment as to fall trade has been helped by these developments, and fall buying is becoming more noticeable, as country merchants are coming in in increasing numbers. In some of the large industries, however, quieter trade is reported in some branches, with prices easing. Pig iron and some finished lines are reported lower, and reports show less activity in current building. Steel rails were in relatively good demand, considering the volume of orders placed earlier in the year; new business amounts to about 40,000 tons. Demand for plates continued strong, car builders and shipyards being the principal factors. In the West specifications for structural material came in quite fully, but new business was quiet. Old material is in heavy supply and prices are lower. Although copper has finally worked below 20 cents, many in the metal trade look for still lower prices. *Bradstreet's* reports 157 business failures during the week ending Aug. 8, against 142 in the previous week and 137 in the corresponding week last year.

THE CHICAGO SUBWAY.—It is stated from Chicago that the chief concern of the Chicago Subway at the present time is not how much it can show in earnings, but how well it can handle freight. The volume of traffic offered is expanding daily. The Chicago & Western Telephone Company closed a contract early in the year for the lease of the tunnel company's telephone system. Plans are completed for rushing work on the installation of 100,000 automatic telephones. There are only 7000 or 8000 such instruments in use now, but according to the terms of the contract there must be 20,000 by the end of the first year, and not less than 10,000 additional each succeeding year until the total has reached 100,000. An order for all the equipment was placed some time ago with the Automatic Electric Company, involving about $4,000,000. The lessor company collects all revenue until 20,000 instruments are installed, but its compensation will be only $5 per year for each telephone if the agreement is carried out. Then the lease will be signed and the new company will pay $1,500,000 for the plant as it stood Jan. 1, 1907. The lease runs during the life of the franchise, 27 years. Subsidiary companies will take care of the long distance business.

UTILIZING TOLT RIVER.—The Tolt Power & Transportation Company has petitioned for the condemnation of certain lands in King County adjacent to the Tolt River, State of Washington. The company was organized to utilize the water power of the Tolt River and to convey water by ditches or flumes to points of use, and also to develop and furnish electric power to cities and towns in King County. The petition states that there is urgent demand for 50,000 electric horsepower in the cities and towns of King County, and in order to supply it the petitioners intend to secure franchises and rights-of-way. It is stated in the petition that the company does not want the timber condemned now on the lands which are desired, and that it is willing the present owners should cut it off. The lands desired are owned by the Weyerhaeuser Timber Company and the Thomas Irvine Timber Company.

THE NEVADA-CALIFORNIA POWER COMPANY, after more than a year of quiet work, has announced its plans for the complete gridironing of the state of Nevada with high voltage power lines, which will call for the expenditure of more than $15,000,000 and will establish the longest power circuits in the world. This company now owns a third of the taxable land in Alpine County in California, where it has power generating facilities of the most extensive character. Thence it will run power lines that not only will supply Reno, Carson, Virginia City, Goldfield, Tonopah, Rhyolite and all of the southern Nevada mining camps, but will reach over into Greenwater and Death Valley copper districts and thence clear across the state of Nevada to Ely and the Cherry Creek mining district with a 100,000-volt line.

THE TELLURIDE POWER COMPANY, which owns extensive power-plant properties in Colorado, Utah and Idaho, and of which L. L. Nunn is manager, has secured the Bear Lake reservoir site and will impound the flood waters. These will be used for the irrigation of some 30,000 acres of land, but the principal feature of the enterprise is the generation of power which will be taken southward for use in Utah. The project is on a large scale. Four hundred cars of pipe are arriving. The pipe line is eight feet in diameter. Five miles of this pipe will be laid down the canyon, securing a head of some 500 feet for the feed pipe supplying the water wheels. This plant will cost about $2,000,000, and is the greatest undertaking of the kind in the state.

GENERAL ELECTRIC ORDERS.—A statement issued by the General Electric Company shows that the company in the first six months of the current fiscal year received orders aggregating a valuation of $35,096,117, as compared with $28,966,922 in the corresponding period of last year. Sales billed in the first half of the current fiscal year aggregated $35,406,878, as compared with $25,915,762 in the corresponding period of last year. The company is pursuing a conservative policy, however, as to the immediate future, believing that the anti-corporation agitation must necessarily tend to restrict new business, until there is a change for the better.

PALACE HOTEL, SAN FRANCISCO.—The Palace Hotel Company has accepted the bid of the Westinghouse Electric & Manufacturing Company for four 300-kw, three-wire, 250-volt, 150-r. p. m. engine-type generators, together with four generator panels and nine feeder panels. Each feeder will be protected by an automatic circuit-breaker, mounted on the feeder panel. The complete electrical equipments will be installed under the supervision of the Westinghouse engineers.

BIDS INVITED FOR PLANT.—Bids will be received until Aug. 27 at the City Hall of Trenton, Ill., for furnishing and erecting addition to building, engine, dynamo, switchboard, heater, boiler feed pump, piping and pole line material, for extending the present direct-current three-wire lighting system. Specifications are on file at the office of Newton Rule, city clerk, at Trenton, Ill., and at the office of the engineer, W. A. Fuller, 1122 Chemical Building, St. Louis, Mo.

WEST POINT, GA., DEVELOPMENT.—Among the recent developments in the South, there is little doubt that the undertaking of the West Point Manufacturing Company, of West Point, Ga., is one of the most extensive of the current year. This company through its engineers, Mr. Chas. T. Main, of Boston, Mass., and his hydraulic expert, Mr. John E. Porter, is making an installation at Langdale, Ala., a few miles below West Point, which will harness the waters of the Chattahoochee River. A reinforced concrete power house approximately 40 feet wide by 200 feet long will be built at one end of the dam, and in this plant will be installed the hydraulic and electrical machinery. The hydraulic equipment will consist of two 39 in. and eight 60 in. improved New American turbines which will be of the vertical shaft type and arranged for installation

in open concrete flumes. These turbines will operate under 13 ft. head and develop over 3000 horse-power. The vertical shafts will be extended sufficiently to place the gearing and harness work for the horizontal shafts on the power-house floor approximately 10 feet above head water level. Each of the 39 in. wheels will drive by means of bevel mortise gears a horizontal shaft at 168 r. p. m. from which a 100-kw exciter will be belted. Four of the 60 in. turbines will drive a 750-kw, 150-r. p. m., 3-phase, revolving-field, 60-cycle generator, there being two turbines on each side of the generator, connected by means of bevel mortise gears to horizontal shafts which will be directly coupled to both ends of the generator shaft. The other for 60 in. turbines will be divided into two parts, each consisting of two wheels geared to a common jack shaft and direct-connected to a 550-kw, 150-r. p. m., 3-phase, revolving-field, 60-cycle generator. There will be 19 sets of head gates for regulating the flow of the water into the wheel chambers, each of these gates being about 8 ft. 6 ins. wide and 10 ft. 6 ins. high, of the double-stem type and operated by special worm wheel and spur rack hoisting mechanisms. The water-wheel machinery complete with all gearing harness work, head gate hoists, trash racks, etc., is being built by the Dayton Globe Iron Works Company, of Dayton, Ohio, while the electrical apparatus will be furnished by the Westinghouse Electric & Manufacturing Company.

WESTINGHOUSE BUSINESS.—If the country is on the eve of a business recession, says the *Wall Street Journal*, the showing of the Westinghouse companies does not reflect it. It is significant that all of the Westinghouse companies are not only working to their full capacities, but that orders continue to be received in excess of the average shipments. The Westinghouse Air Brake Company closed, on July 31, its most prosperous fiscal year with the largest gross and net earnings in its history, and has now more men on its payroll than at any previous time. The Union Switch & Signal Company, which is adding to its plant to meet the increased demands for its apparatus, has in gross and net earnings for the first six months of the present year exceeded the figures of the corresponding period of last year, indicating, with orders and contracts in hand, that more men rather than less will be required in the near future. The Westinghouse Machine Company, makers of turbines, gas and steam engines, has also shown a large increase in gross and net earnings for the first four months of the present year, and has a large volume of orders in hand which is being constantly augmented by the receipt of important new ones. The Westinghouse Electric & Manufacturing Company continues to improve its showing in shipments and in receipt of new and profitable orders. It is now expected that the Electric Company's shipments for August will be greater than in any previous month of its history, and with the new orders already received orders for the month will be in excess of shipments.

A WONDERFUL BATTERY of the primary type is again heralded to a waiting world in the following special dispatch from Milwaukee, of Aug. 8: "A company has been formed in Milwaukee with $5,000,000 capital to put on the market a new battery which will provide electric light, heat and power at astonishing prices. A house can be fitted up for $200, it is declared, and the company will retain $175 of this as profit. Frank C. Curtis, a local chemist, has discovered a chemical compound which, used in a new style of battery, develops great power. The device has been in use on the Northwestern Railway for three months and in cars of the Pullman Company for the same time and will be installed on all cars of these companies. The new company has as its leading stockholders the Pullman Company, President Marvin Hughitt of the Northwestern Railway, President Underwood of the Erie Railway, E. H. Johnson, superintendent of the Western Union at New York; Frank Taber, of Denver, a mining engineer, and others. The company will not put its stock on the market, the entire amount having been subscribed for after the railroad test was completed." President Underwood doesn't seem to know much about this, and Superintendent Johnson is an unknown quantity.

TRUCKEE RIVER DEVELOPMENT.—The Nevada Consolidated Mining & Milling Company, Reno, Nev., has an extensive electrical equipment, comprising an 85-kw, three-phase, 1150-volt, 60-cycle generator belted to an Erie automatic engine, supplying the town of Olinghouse with light and power, and the mines of the Nevada Consolidated in the White Horse district. The 50-stamp mill belonging to the above company is situated six miles below on the Truckee River, and the arc and incandescent lighting and nine motors already installed are driven by a 75-kw, 250-volt, direct-current generator, belted to an Erie engine. The company is preparing to instal a 600-hp hydroelectric plant on the Truckee River, having contracted with the Government for the necessary power to be taken from the Truckee-Carson irrigation canal Fifty more stamps are to be added to the mill, and the entire 100 will be motor driven. The Nevada Consolidated also controls the Wadsworth Light & Power Company supplying that town with electricity and water. Hence the Nevada Consolidated Company is in the market for quite a large amount of equipment. All the existing plant is Westinghouse. Mr. Frank Huff is the chief electrician.

POWER IN TEXAS.—According to advices from Rockdale, Tex., Messrs. Joseph J. Henry and T. B. Burbridge, of Denver, Colo., have been there in the interests of a proposed $3,500,000 electric power system in the lignite fields near the town of Rockdale. This concern will erect a large power plant in the coal fields and transmit to cities over the state. The plan is to offer each local company a fair price for their plant and franchise and if they refuse to sell, secure a franchise and freeze the little concerns out. But where little concerns will contract to use their power they offer the same to them at a lower rate than the present cost of production. Mr. Burbridge, in addition to a franchise in Waco, now has option on plants in Taylor, Temple, Rockdale, Waco, Cameron, Bryan, Hearne, Calvert, Belton and one representative is now working on Austin and Houston, while others close with Brenham, Marlin, Palestine, Georgetown and other towns in the circuit.

WHERE IT HURTS.—A special dispatch from Boston, of Aug. 13, says: "A Boston capitalist who has created many millions of wealth in the building of street railways, water powers, etc., says: 'The administration has started a wave of hysterical prejudice against corporate interests from the Atlantic to the Pacific over which the President no longer has control and which he could not stop if he desired to. It is a counterpart of the Granger agitation in the 70's, which, when started, had to run its course. I have plans in embryo for the organization of two immense water power propositions, but I have shelved them for 12 months, for I realize that it would be foolhardy to attempt to finance any new propositions now and I can see no promise of any change in conditions for a year. Business will naturally feel the effect of the general suspension of new construction and new enterprise.'"

CHICAGO DRAINAGE POWER.—It is stated that the Department of Electricity of the city of Chicago is making preparations to extend the underground conduit system for its various wires. Several extensions will be made at different points about the city, but the principal part of the present work will be the construction of a new conduit on Western Avenue to accommodate the cables which will carry the electrical energy contracted for from the Lockport plant on the Drainage Canal. Over 38,000 feet of six-duct and eight-duct conduit will be laid in concrete.

MECHANICAL DRAFT for boilers is being installed by the B. F. Sturtevant Company, of Boston, Mass., for the Kitson Machine Shops, Inc., Lowell, Mass.; R. B. Whitacre & Co., St. Paul, Minn.; State Hospital, Morganton, N. C.; Bemis & Call, Springfield, Mass.; General Chemical Company, Dundee, N. J.; General Chemical Company, Laurel Hill, L. I.; Lovegrove & Company, Inc., Philadelphia, Pa., and International Paper Company, Otis Mill, Chisholm, Me.

SOUTH CAROLINA POWER.—The Savannah River Power Company has begun development work at Cherokee Falls and Calhoun Falls, on the Savannah River, below Anderson, S. C. About 40,000 electrical horse-power will be developed. A large cotton mill has been built at Calhoun Falls, two and one-half miles from the power site. Other developments are contemplated in the vicinity.

ANTI-TRUST WAR.—The attorneys general of the Mississippi Valley states met at St. Louis on Aug. 12, to formulate plans for a National conference of attorneys general, at which concerted action to enforce various state anti-trust laws can be arranged. The meeting was at the invitation of Attorney General Herbert S. Hadley, of Missouri.

THE NORTHERN ENGINEERING WORKS, crane builders, Detroit, Mich., have installed power station cranes, one of 20 tons capacity for the Toledo Gas & Electric Company, and two of 20 tons capacity in the Murphy Power Plant at Detroit, Mich.

Financial Intelligence.

THE WEEK IN WALL STREET.—Various influences were at work during last week to supplement the fervent heat of summer in taking the elasticity and spring out of the stock market. In England, consols went to their lowest point in 60 years, back to the levels of the days when Louis Napoleon was planning coups d'etat and new empires and alarming the good folk across the Channel. In the Mediterranean, France and Spain have been hammering at the seaward gates of Morocco, while Germany looked on in ill-concealed envy and disgust. In these United States, the height of the wave of hatred and revenge against trusts was seen in the infliction of a fine of nearly $30,000,000 on that sinner and scapegoat, the Standard Oil Company, for rebating, and for indulging in practices that are only too common, but which in the case of these big "combines" are subject to well-defined legal pains and penalties. On top of all this has come the threat of other fines on the railroads. A market that held its own under all these adverse conditions would be a marvel. People who are tired of prosperity never have to suffer long from the grievance, and last week saw losses inflicted on the nation that hardly a civil war could match. There must and will be a change, a swing of the pendulum toward the sane and normal, but in the meantime we must all take part of the loss forced upon the country as a whole by the exaggerated fear of capital in a day when labor earns more than it ever did and when capital never received so small a percentage of the wealth it helps to create. Fortunately there are signs of sober second thought, and even should prices go lower they will merely offer the greater inducement to investors and the growing number of those who save something every year. The course of prices during the week was downward and then to a lower scale, and the depression of last March has been more than equalled. The above table gives the quotations of Aug. 13.

NEW YORK.

	Aug 6	Aug. 13		Aug 6	Aug. 13
Allis-Chalmers Co.	19	9¼	General Electric	132	128¾
Allis-Chalmers Co. pfd..	26	25	Hudson River Tel.....	—	—
Am. Dist. Tel.....	—	—	Interborough Met. com.	14¼	10
American Locomotive..	56	53	Interborough Met. pfd.	41	29⅞
Amer. Locomotive pfd..	105	103	Mackay Cos.	68	62⅛
American Tel. & Cable.	75	—	Mackay Cos. pfd.....	66½	62
American Tel. & Tel..	—	105	Marconi Tel.	—	—
Brooklyn Rapid Trasit,.	53½	46½	Metropolitan St. Ry...	—	—
Electric Boat	33	—	N. Y. & N. J. Tel....	—	—
Electric Boat pfd.....	80	—	Western Union Tel....	77	75⅛
Electric Vehicle	—	—	Westinghouse com.....	143¼	130
Electric Vehicle pfd...	—	—	Westinghouse pfd.....	—	—

BOSTON.

	Aug 6	Aug. 13		Aug 6	Aug. 13
American Tel. & Tel....	107¼	105	Mass. Elec. Ry. pfd....	55	54
Cumberland Telephone.	—	102	Mexican Telephone....	2	—
Edison Elec. Illum....	211	209	New England Telep....	109	—
General Electric	—	—	Western Tel. & Tel....	—	—
Mass. Elec. Ry.....	—	12¼	West. Tel. & Tel. pfd..	—	—

PHILADELPHIA.

	Aug 6	Aug. 13		Aug 6	Aug. 13
American Railways....	48	48	Phila. Electric	8	7⅞
Elec. Co. of America..	9⅛	8⅞	Phila. Rapid Transit...	19¼	16⅞
Elec. Storage Battery..	50	47	Phila. Traction.....	—	93
Elec. Stor. Battery pfd.	—	—			

CHICAGO.

	Aug 6	Aug. 13		Aug 6	Aug. 13
Chicago City Ry.....	155	160	National Carbon	72	—
Chicago Edison	—	—	National Carbon pfd...	112	—
Chicago Subway	—	—	Union Traction	—	—
Chicago Tel. Co.....	—	—	Union Traction pfd...	—	—
Metropolitan Elec. com.	22	21½			

INDEPENDENT TELEPHONE BONDS.—Full details have been given out of the proposed reorganization plan devised by the committee of three for the United States Independent Telephone Company. The agreement which the bondholders are asked to sign binds them to take bonds of the new company that will be formed as the result of the reorganization to an amount equal to 20 per cent of their present holding of bonds. The consents are not to become binding unless signed by 90 per cent of the bondholders of the United States and Securities companies. The new company will issue $6,000,000 stock and $3,250,000 bonds. With each purchase of bonds the bondholders of the United States company will receive 40 per cent of stock, based on the present holdings; each bondholder of the Securities company will receive 45 per cent of his present holdings. The existing property, which includes the Stromberg-Carlson Company, is regarded as being worth twice the amount of the bonds. Persons who own a $1,000 bond of the United States company, upon paying $200 will receive $200 in bonds of the new company, and $400 in stock. Each person owning a $1,000 bond of the Securities company will receive, on paying $200, bonds of the new company for $450 and stock for $400. The bonds of the Securities company are regarded as much more valuable than those of the United States company; hence the larger percentage of bonds and stock of the new company given for the payment of the 20 per cent of the face value of the present bonds that will be foreclosed. The plan specifies the uses to which the $3,000,000 of bonds are to be put. The exact division will be: Rochester Telephone Company, $840,000; Syracuse Telephone Company, $840,000; Utica Telephone Company, $70,000; Stromberg-Carlson Company, $1,000,000. The $1,000,000 is furnished to the Stromberg-Carlson Company by purchasing and carrying the outstanding notes of the company, aggregating $775,000, and lending the company $225,000. The sums to be furnished the Rochester, Syracuse and Utica companies will enable such companies to pay off all floating indebtedness and make substantial provision for the extension and completion of these systems on a business basis. There is a margin of $250,000 left out of the $3,000,000 bond issue for emergencies. It is proposed to raise telephone rates all around.

BOSTON EDISON GROWTH.—Advices from Boston discuss the local situation as follows: "Since the Edison Company declared the extra dividend of 1 per cent on its stock last June, the question has naturally arisen as to its continuance. Speaking of the company's dividend policy, an official says: 'When the directors at their last meeting voted to declare an extra dividend of 1 per cent, their action was based on the results for the year ended June 30 last. The net earnings for that period were so satisfactory that the directors felt justified in making an extra disbursement, especially as a reduction in electricity prices had been made to consumers during the year. As to the continuance of the extra dividend the board took no position. The petition now before the gas commissioners for a further reduction in electricity prices is a factor the result of which will have a bearing on any further extra dividend declarations.' Prices of the Edison Company of Boston have averaged 8 per cent to 10 per cent lower this year than during the previous year, and the customers used electricity from 5 per cent to 6 per cent longer in time during the previous year. The gross earnings for the year were approximately $4,050,000, against $3,780,911 for the fiscal year ended June 30, 1906."

BELL TELEPHONE SITUATION.—Advices from Boston state that since Jan. 1 last, the subsidiary companies of the American Telephone & Telegraph Company have been making marked progress in the reduction of their floating debt. It has been one of the cardinal principles of the present administration that the associate companies should cut down the total of their obligations which they owe either to the outside public or to the Western Electric Company. On Dec. 31, 1906, 23 of the subsidiary companies had outstanding accounts payable of $75,518,451, against which were bills receivable of $16,941,282, leaving a net floating debt of $58,577,169. Since the first of the year 15 of the associate companies have issued new securities to the extent of $45,736,100 for the reduction of floating debt, etc., and it is figured that the floating debt has thus been reduced 70 per cent in the last seven months.

CUMBERLAND TELEPHONE.—The Cumberland Telephone stockholders have approved an increase in the authorized capital stock from $20,000,000 to $20,200,000. The increase of $200,000 was made to allow sufficient authorized stock to meet the October subscriptions on the $3,362,400 new stock offered to stockholders last January. The final payment of 25 per cent is to be made Oct. 1.

QUEENS ELECTRIC BONDS.—There was a hearing last week before Commissioner McCarroll, New York City, on the application of the New York & Queens Electric Light & Power Company for the approval of a bond issue. The company expects to issue bonds for about $1,000,000. The money is to be used for extensions and improvements.

WILLIAMS TELEPHONE & SUPPLY.—An involuntary petition in bankruptcy has been filed against the Williams Telephone & Supply Company, by the White Tool & Supply Company, the Cleveland Tool & Supply Company and Bates, Fouts & Hull, attorneys. It is alleged that the company owes debts of about $45,000, and that it has confessed its inability to pay them.

DIVIDENDS.—The North American Company, which controls various large lighting properties, has declared a quarterly dividend of 1¼ per cent on the capital stock, payable Sept. 2.

GENERAL NEWS

Construction News.

SAFFORD, ARIZ.—The question of constructing an electric light plant and water works system is reported under consideration.

HEBER, ARK.—W. H. Horton has secured a franchise to install electric light and heating plant in this place.

ALAMEDA, CAL.—Plans are being made to hold an election to vote on the proposition to issue $300,000 in bonds for public improvements, which include the erection of an addition to the power house of the municipal electric light plant, the installation of additional machinery and the construction of a reservoir.

DUNSMUIR, CAL.—The Southern Pacific Railroad Company has made application for permission to take 5000 miners' inches of water from the Sacremento River at Dunsmuir. The company proposes to erect an electric plant at this place to furnish electricity for the operation of its railway shops.

EXETER, CAL.—Glass & Fisher have secured the contract for the construction of the new power house of the Visalia Electric Railway Company at this place. The building will be of re-enforced concrete and will cost $20,000. The power station will furnish electricity for operating the electric railway between Exeter and Lemon Cove.

LOS ANGELES, CAL.—The West Ninth Street car line is to be extended from its present terminus at Tenth Street and Vermont Avenue to Grammercy Place.

NEVADA CITY, CAL.—The Bay Counties Power Company expects to complete its transmission line from the Rome power house to the Alaska mine at Pike City, a distance of about ten miles, during the fall, when the machinery at the mines will be operated by electrical instead of steam power.

OCKENDEN, CAL.—Extensive improvements are to be made at Ockenden, which include the construction of an electric light plant and an artificial lake. The electric plant will have sufficient capacity to light the canyon adjacent to Ockenden.

REDDING, CAL.—At a recent special meeting of the stockholders of the Pacific Power Company, it was decided to place 150,000 shares on the market among the big stockholders and their friends on the installation plan, the installments aggregating sufficient each month to carry the proposition through to a successful issue, completing the auxiliary plant and placing poles and wires to Red Bluff.

SAN JOSE, CAL.—Charles J. Kuhn, general manager of the National Park Electric Power Company, writes that preliminary work is now being done for the construction of its plant, actual work on which will begin in the near future.

SONORA, CAL.—All the property and extensive holdings of the Big Creek Mining Company are to be taken over by a syndicate of Maine and Massachusetts men, of which Lester Wiley is managing director. All surveys for the installation of an electric plant have been completed. The plant will have a capacity of 22,000 horse-power. It is said that the pipe line alone will cost about $250,000.

STOCKTON, CAL.—The Stanislaus Electric Power Company, which is building a large power plant on the Stanislaus River in Toulumne County, is procuring rights of way for its transmission line through San Joaquin County. Rights through Calaveras County from the plant, 12 miles east of Vallecito, have been procured and the line will run from that point direct to San Francisco. The company expects to develop 30,000 horse-power. The transmission line is to be carried on steel towers 50 feet high, placed from 800 to 1000 feet apart.

STOCKTON, CAL.—The City Trustees of Stockton have been temporarily restrained by injunction proceedings brought by the Stockton Gas & Electric Company, from enforcing a recently adopted ordinance regulating the rates of gas and electricity charged to consumers by the corporation. The company has also asked for a permanent injunction and for a judgment, declaring the Council acted in excess of its authority in attempting to fix the rates. The hearing has been set for Sept. 3. The suit will determine the legality of the ordinance. The company alleges that the rates at which it has been supplying gas and electricity to its customers are reasonable and only sufficient to enable return on the investment. It alleges that the rates fixed by the Council are not sufficient to earn a just return. The rates fixed by the Council were $1.25 per 1000 cu. ft. for manufactured gas; 90 cents for natural gas; 7 cents per kw-hour for electricity for lighting, and 4 cents per kw-hour for electricity for power purposes.

ROCKY FORD, COL.—It is reported that the city authorities are contemplating making a change in the street lighting system here.

BRIDGEPORT, CONN.—Arrangements are being made for erecting an addition to the boiler house and installing a new engine at the power plant of the Bryant Electric Company.

BRISTOL, CONN.—The town authorities have entered into a contract with the Bristol & Plainville Tramway Company for lighting the town for the coming year. The company is to furnish not less than 99 arc lamps of 1200 candle-power at $87.50 per lamp per year. The lamps are to burn from sunset to 1 a. m. and from 5 a. m. to daylight.

NEW BRITAIN, CONN.—The Stanley Works has commenced the work of surveying and laying out the site for the power plant to be erected in the town of Kent and for location of the dam to be built at that place.

TERRYVILLE, CONN.—New boilers for the power plant of the Eagle Lock Company are being installed by the D. M. Dillon Company, of Pittsburg, Pa.

WALLINGFORD, CONN.—Work is progressing rapidly on the municipal auxiliary electric lighting plant at "Quinnie," and it is expected to have the plant ready for operation about the first of October, when a day service will be established.

WATERBURY, CONN.—Owing to low water the power plant of the New Milford Power Company at Bulls Bridge, which furnishes electricity for operating the light and traction systems in the Waterbury, New Britain and Southington districts of the Connecticut Railway & Lighting Company, is unable to meet the demands made upon it. The two local steam plants have been put in operation, and the steam plant at Milldale is now furnishing power for the electric railway system at Southington.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until Sept. 3, to furnish at the navy yards, and naval stations the following supplies: Mare Island, Cal., schedule 192—incandescent lamps, electric fixtures, etc. Puget Sound, Wash., schedule 201—incandescent lamps, electrical fittings, etc. Also until Aug. 20 as follows: Newport, R. I., schedule 168—motors. Schedule 181—battery cells. New York, N. Y., schedule 143—wireless telegraph apparatus. Schedule 169—insulators, porcelain tubes, resistances, dry cells, etc. Schedule 170—hydrometers. Schedule 181—portable voltmeters and ammeters. Annapolis, Md., schedule 178—duplex and boiler feed pumps, tools, etc. Schedule 179—electrical instruments, etc. Schedule 181—copper conductor. League Island, Pa., schedule 168—electric panel boards. Washington, D. C., schedule 173—motor, starting panel, circuit breaker. Applications for proposals should designate the schedule desired by number. E. B. Rogers, paymaster general, U. S. A.

AMERICUS, GA.—Work has commenced on the large electric plant to be installed in Americus. Under its franchise the company will construct and operate a street railway system, and furnish the city with electricity and water for a term of 20 years.

COLUMBUS, GA.—Electricity is rapidly displacing steam for manufacturing purposes in this city. Practically all new manufacturing plants are operated by electricity, and it is said that several older industrial enterprises are considering electrical installations.

COLUMBUS, GA.—The Georgia Fertilizer Company has contracted with the Columbus Power Company to furnish electricity for operating its new plant, which is being built several miles east of Columbus. The Columbus Power Company will erect a new transmission line from its plant on the Chattahoochee River to the site of the new plant, a distance of between five and six miles.

COLUMBUS, GA.—The Central of Georgia Railway Company has decided to equip its shops in this city with electrical machinery, and has entered into a contract with the Columbus Power Company to furnish electricity for operating the plant. The company also awarded a contract for electrical equipment for its Savannah shops, and the company's new shops now being built at Macon will also be driven by electricity.

ALEDO, ILL.—The City Council has passed an ordinance granting a franchise to the People's Telephone Company, of Mercer County.

GREENFIELD, ILL.—The City Council has granted A. Y. Collins a franchise for an electric light plant.

NAUVOO, ILL.—The Mississippi Valley Electric Railway Company has awarded the contract for the construction of its road to Fort Madison, Ia., to the Federal Construction Company, of New York, N. Y.

OAKLAND, ILL.—The plant and system of the Embarrass Telegraph & Telephone Company has been purchased by Milton Collier, of Dana, Ind. The system includes the exchanges of Oakland, Borton, Redmon and Kansas.

CLAY CITY, IND.—The City Council is reported to be considering the question of constructing a municipal electric light plant.

EVANSVILLE, IND.—Preliminary steps are being taken by the Evansville Gas & Electric Company to place its wires underground in this city.

FT. WAYNE, IND.—Charles F. McBride, secretary of the McBride Electrical Construction Company, which has been awarded the contract for the construction of the new municipal lighting plant and for the installation of the distributing system, has been in the city recently to make arrangements for the erection of the plant, work on which will soon commence.

HAZLETON, IND.—C. L. Howard, city clerk, writes that a petition is being circulated for an election to vote on the proposition of construction of an electric light plant.

PETERSBURG, IND.—The Cumberland Telephone Company has refused to accept the franchise offered by the City Council, demanding two per cent on its annual gross earnings and a cash bonus for a 20-year franchise. The company has closed its exchange and is removing telephones from the residences of its subscribers. The Council in retaliation has declared the company interlopers and has given the company 59 days to remove its poles from the streets of the city.

TERRE HAUTE, IND.—E. E. Barclay, of Springfield, Ill., secretary of the St. Louis, Terre Haute & Quincy Traction Company, states that the company will let contracts for construction of its road soon. The road will extend from Terre Haute, Ind., to Quincy, Ill., a distance of about 250 miles. Surveys have been made for 140 miles, and the right of way obtained. Edward Yates, of Springfield, Ill., is president.

WASHINGTON, IND.—The stockholders of the local electric light company have directed the trustees of the plant to turn over to the city all of the books, machinery, etc., putting the plant in direct control of the City Council with power to enter into an agreement with a contractor to repair the plant, taking a mortgage on the property until final payment is made. The purpose is to install new machinery, including boilers and electric apparatus, a new system of arc lamps and extend the wiring system. The city is considering the proposition and may refer the matter to a vote of the citizens.

TULSA, I. T.—The Mid-Continent Traction Company, recently incorporated, will build an interurban electric railway connecting Tulsa, West Tulsa, Red Fork, the Glenn Pool oil fields and Sapulpa. The road will be 20 miles long. Most of the right of way has been secured and construction contracts will be let within 60 days. The officers of the company are: F. L. Smart, of Kansas City, Mo., president; P. J. Evans, of Kansas City, secretary, and Graham Burnham, of Tulsa, I. T., general manager.

WEBSTER CITY, IA.—The City Council is contemplating increasing the capacity of the municipal electric light plant by the installation of another engine and generator.

PITTSBURG, KAN.—F. C. Borden, of Wichita, has secured the contract for erecting the Century Building at Fourth Street and Broadway. The building will cost about $100,000 and will be equipped with an electric plant.

COVINGTON, KY.—The City Council has passed the ordinance authorizing the Mayor to enter into a contract with the Union Light, Heat & Power Company for the erection of 50 additional arc lamps to be placed in Central Covington. According to the terms of the contract the city will get arc lamps at $55 per lamp as soon as 450 lamps are used.

HOPKINSVILLE, KY.—The stockholders of the Cumberland Telephone & Telegraph Company have voted to increase the capital stock of the company from $20,000,000 to $20,200,000, and to move the legal offices of the company to Louisville.

MURRAY, KY.—W. O. Wear, city clerk, writes that bids will be received on Aug. 23, for the purchase of $20,000 in bonds, which were issued for electric light and water improvements.

CUMBERLAND, MD.—The Chesapeake & Potomac Telephone Company has petitioned the City Council for a permit to establish a conduit telephone system in Cumberland. It will cost the company about $100,000 to place its wires underground in this city.

ASHBURNHAM, MASS.—The citizens have decided to call a special town meeting at an early date to vote on the proposition of purchasing the poles and wires of the old electric light company and to take action on the best method of lighting the town.

ATTLEBORO, MASS.—The Attleboro Gas & Electric Company has been given permission by the State Board of Gas and Electric Light Commissioners to issue $75,000 additional capital stock, the proceeds to be used for enlarging the plant.

BROCKTON, MASS.—The Brockton & Plymouth Street Railway Company has petitioned the State Railroad Commissioners for authority to issue additional capital stock to the amount of $110,000, the proceeds to be used for payment of its floating indebtedness.

MARLBORO, MASS.—The Board of Gas and Electric Light Commissioners has given its approval to an issue of 1700 shares of additional capital stock of the Marlboro Electric Company, and has ordered that the new stock shall be offered to the present stockholders of the company at $100 per share. The proceeds of the stock issue are to be used as follows: $35,800 for the payment and cancellation of the entire bonded indebtedness of the company; $99,000 to the cancellation of an equal amount of floating indebtedness of the company, and the balance, $35,200, to the cost of permanent additions to the plant made subsequent to July 1, 1907.

NEWTON, MASS.—The Newton Street Railway Company and the Waltham Street Railway Company have applied to the State Board of Railroad Commissioners for permission to consolidate under the name of the Newton Street Railway Company. It is proposed to issue new capital stock of the Newton Street Railway Company to the amount of $100,000, to be exchanged for the stock of the Waltham Street Railway Company, share for share, after which the stock of the Waltham company is to be cancelled and retired.

NORTH ATTLEBORO, MASS.—G. K. Webster & Company are making arrangements to avail themselves of electrical power now being furnished by the municipal plant and have installed a 35-hp motor to operate their factory.

WORCESTER, MASS.—The Coughlin Electric Company, of this city, has secured the contract for wiring and installing electric fixtures in the new Slater Building, at Main, Pearl and Elm Streets.

WORCESTER, MASS.—The contract for equipping the fair grounds of the Worcester Agricultural Society for electric lighting has been awarded to W. L. Brown. The equipment will be permanent, so the fair grounds will be available for other purposes at night.

GRAND RAPIDS, MICH.—The City Council has granted a franchise to the Grand Rapids-Muskegon Power Company. W. A. Foote is manager.

IRON MOUNTAIN, MICH.—The Michigan State Telephone Company will rebuild its system at this place and install the central energy system at a cost of about $16,000.

LANSING, MICH.—W. E. Tench & Company have secured the contract for the construction work of 40 miles of electric railway for the Lansing-Jackson Interurban Railway. Work will commence at Holt, about five miles south of Lansing. T. W. Atwood is president of the railway company.

PAINESDALE, MICH.—The Champion Copper Company is designing a new plant, which will be located about five miles from its first mining location. The plant will be equipped with two 2000-kw, 13,200-volt, 60-cycle, three-phase generating units and 1500-hp water tube boilers. Three substations will be built, each to be equipped with three 400-kw oil insulated self-cooled transformers. It is expected to complete the building this summer and to install the machinery next winter. The plant will furnish electricity for Painesdale, Trimountain and Baltic. W. A. Rankin is electrical engineer.

TRAVERSE CITY, MICH.—The Carter Construction Company has petitioned for a franchise to construct and operate a street railway in this city.

UNION CITY, MICH.—The improvements to the municipal power plant, which operates the electric lighting and water works systems, has been completed and the service resumed after a cessation of five weeks. The improvements include a new engine and boilers and an addition to the power house.

DULUTH, MINN.—It is reported that the Duluth Boat Club has decided to install a lighting plant at Spirit Lake.

GRACEVILLE, MINN.—The citizens are contemplating improvements to the electric light plant and the water works system, which include the rebuilding of the lines of the lighting system and changing the pumping system. The village will be in the market for an air compressor. H. A. Raitze is superintendent.

ST. PAUL, MINN.—The Minneapolis General Electric Company has served notice upon Mayor J. C. Haynes that it could not comply with the portion of the ordinance, recently passed, requiring the company to reduce its rates for electricity for lighting and power. The Walker ordinance passed last month requires that the maximum price for electricity shall be eight cents for lighting and six cents for power purposes.

JOPLIN, MO.—The Joplin & Pittsburg Street Railroad Company has filed with the city clerk its acceptance of the amended franchise granted by the City Council. Work on the construction of the road will commence as soon as the right of way is obtained.

KANSAS CITY, MO.—The county court has granted W. E. Winner the right of way for an electric railway along the Blue Valley Boulevard. In return for the franchise Mr. Winner agrees to pay one-half of the cost of paving the boulevard and one-half of the cost of the bridge across the Blue River. The electric line is to connect with the Swope Park line of the Metropolitan Street Railway.

ROLLA, MO.—It is reported that an appropriation of $10,000 has been made for an electric plant at the Soldiers' Home.

OMAHA, NEB.—The Independent Telephone Company has been granted a permit to erect an additional story to its exchange building on North Twenty-fourth Street, to cost $5,000.

STANTON, NEB.—The Olds Manufacturing Company has secured the contract to install an electric light plant.

LOVELOCK, NEV.—W. B. Joslyn, manager of the Lovelock Light & Power Company, writes that the company will install at once a 2000-light alternating current electric plant. The equipment of the plant has not yet been decided upon.

RENO, NEV.—The Nevada-California Power Company has announced its plans for the complete gridironing of the state of Nevada with high-voltage power lines, which will call for an expenditure of more than $15,000,000. The company now owns a third of the taxable land in Alpine County, Cal. From there it will build transmission lines that not only will supply Reno, Carson, Virginia City, Goldfield, Tonopah, Rhyolite and all of the southern Nevada mining camps, but will reach over into Greenwater and Death Valley copper districts and thence across the state of Nevada to Ely and the Cherry Creek mining district with a transmission line of 100,000 volts. R. E. Maynard is vice-president.

BRIDGETON, N. J.—The Bridgeton Electric Company is rebuilding its plant at a cost of about $100,000.

CAMDEN, N. J.—The old power house of the Public Service Corporation, at the foot of Seventeenth Street, East Camden, has been

abandoned, the company having transferred the lighting plant to the new power house on Cooper's Creek, below Federal Street.

DEAL, N. J.—The New Jersey Consolidated Water & Light Company is contemplating extensive additions and improvements to its plant, which include the installation of a 1500-kw unit and two 200-hp boilers. The plant is to be made condensing, and lines are to be extended to outside territory. F. M. Inman is superintendent.

JERSEY CITY, N. J.—The Board of Freeholders on Aug. 1 awarded the contract for electric wiring the new almshouse to Reis & O'Donovan, 1123 Broadway, New York, N. Y., and the contract for electric light and gas fixtures to Ferdinand Fleshauer, of West Hoboken, for $2,400.

PARK RIDGE, N. J.—The municipal electric light plant has been seized by a United States marshal in execution of a judgment for $6,951, which was obtained in the United States Circuit Court by the engineering firm which installed the plant. The plant, which was to have been run by water power, has not been a success. The builders claim that this is due to inadequate power, not to improper installation, and the decision apparently supports their claim. The plant cannot be operated advantageously until a considerable amount of money has been expended upon it.

ROCKAWAY, N. J.—E. L. Thompson, of Dover, has purchased a controlling interest in the plant of the Rockaway Electric Light Company and will make improvements to the plant at once.

SILVER CITY, N. M.—A. D. Coleman, 1608 Amsterdam Avenue, New York, N. Y., writes that the Forest Power Company, of which D. E. Woods is president, will construct an electric plant, to cost about $250,000.

BROOKLYN, N. Y.—The Brooklyn Rapid Transit Company, through its subsidiary, the Nassau Electric Railroad Company, has applied to the Public Service Commission for permission to construct tracks on Livingston Street, between Court and Flatbush Avenue, and on Lafayette Avenue, between Flatbush Avenue and Fulton Street, in accordance with the terms of the franchise granted by the Board of Estimate July 29, 1907.

COEYMANS, N. Y.—Zachary T. Vanderpool, of Ravena, has brought an action to restrain the town from carrying out its contract with the Atlantic Light & Power Company to pay $1,600 per year for lighting the village of Ravena with eighty 32-cp electric lamps for a term of five years. When the Town Board advertised for bids for lighting the streets of Ravena the Upper Hudson Electric Company offered to furnish eighty 32-cp electric lamps for $13 a year per lamp, or $1,040 for the year. The Town Board, it is alleged, without any legal reason, threw out the bid of the Upper Hudson Electric Company and accepted the higher bid of the Atlantic Light & Power Company.

FULTON, N. Y.—Work has commenced on the new power house for the Oswego Falls Pulp & Paper Company. The new plant will have a capacity of 2000 horse-power, and will cost between $60,000 and $70,000.

LITTLE FALLS, N. Y.—The citizens have voted in favor of issuing $10,000 in bonds to improve the electric lighting system.

NEW YORK, N. Y.—Owing to the fact that the waste material used as fuel to run the municipal plant for lighting the Williamsburg Bridge has proved unsuitable the plant will be abandoned and the bridge will be lighted by the New York Edison Company. It is said that it cost the city $60,000 each year to operate the plant. The Edison company has agreed to light the bridge for $25,000 per year. The plant will still be used as an incinerator, and may also be used for furnishing heat in the neighborhood.

NIAGARA FALLS, N. Y.—The F. P. Electrical Company, of Buffalo, has secured the contract to install the electric lighting plant on the Niagara State Reservation for $13,731. The plant is to be completed within 90 days.

ROCHESTER, N. Y.—The Board of Supervisors on Aug. 2 passed a resolution authorizing the purchasing agent to advertise for bids for the construction of a lighting plant for the court house, at a cost not to exceed $7,900. The county is now paying nearly $4,000 a year for lighting the building, and it is expected that with its own plant it can be lighted at a cost of about $1,000 per year.

SHERBURNE, N. Y.—The citizens of this village are considering the question of establishing a municipal electric lighting plant, to cost about $15,000.

SYRACUSE, N. Y.—The Village Trustees of Eastwood have granted the Syracuse Rapid Transit Railway Company a franchise to double track the car line through the village on Burnet Avenue. This is to form part of the new line to East Syracuse by way of Eastwood.

WAVERLY, N. Y.—The Waverly, Sayre & Athens Traction Company has been granted franchises in Sayre by which the railway will be able to connect South Waverly with Sayre. The company is planning to build new shops at Sayre.

CHARLOTTE, N. C.—It is reported that the water power at Linville Falls is to be developed. A dam 100 feet high will be built on Linville River near the falls, which will develop 22,000 horse-power. The plant will furnish electricity for lighting and power in the western part of North Carolina, east of the Blue Ridge.

CONCORD, N. C.—The Cannon, Carrabus, Young-Hartsell and Franklin cotton mills in this city are to be operated by electricity beginning about Sept. 1. Over 100 motors will be required in the operation of the four mills.

FAYETTEVILLE, N. C.—The amended franchise of the Carolina Telephone Company has been approved by the town authorities. The company agrees to install a modern double-metallic circuit with long-distance connections. The improvements will cost about $30,000, and the company is given the privilege to increase its rates.

KINGS MOUNTAIN, N. C.—At an election held recently the citizens voted to issue $50,000 in bonds for an electric light plant and water works system.

NEW BERNE, N. C.—The municipal electric lighting plant is being enlarged and new machinery installed.

VALLEY CITY, N. D.—H. F. Halverson, city auditor, writes that the municipal electric lighting plant is inadequate to meet the city's needs, and is to be sold to the highest bidder, bids for which will be received some time this month.

ARLINGTON, OHIO.—O. T. Castor, village clerk, writes that bids for bonds and also for construction of an electric light plant will be opened on Aug. 27 by the Village Council.

ASHTABULA, OHIO.—The capital stock of the Ashtabula Rapid Transit Company has been increased from $150,000 to $500,000.

CINCINNATI, OHIO.—A mortgage has been given by the Cincinnati & Columbus Traction Company to the Union Savings Bank & Trust Company to secure a bond issue of $200,000. The proceeds will be used to pay the present indebtedness and to make certain improvements and extensions.

COLUMBUS, OHIO.—The Board of Public Service has approved the contract and bond of the Allis-Chalmers Company for the installation of new turbines in the municipal electric light plant.

DILLONVALE, OHIO.—The County Commissioners have granted a 25-year franchise to H. T. Roe, of Dillonvale, to erect poles and wires for the transmission of electricity along the Dillonvale and Mt. Pleasant Road.

LIMA, OHIO.—The City Council is considering the installation of an electric plant as an auxiliary to the present pumping plant at the waterworks.

PAINESVILLE, OHIO.—Plans are being made by the Commercial Electric Company to rebuild its plant in this city.

TOLEDO, OHIO.—J. W. Kerr, chairman County Commissioners, writes that all bids opened recently for building and equipping the new power house at the County Infirmary have been rejected.

COTTAGE GROVE, ORE.—Work has commenced on the reconstruction of the plant of the Willamette Valley Company, which was recently destroyed by fire. The new building will be 50 x 150 feet, with a wing 40 x 70 feet. The equipment will consist of a 180-kw Westinghouse generator and a 200-hp Russell engine. The old boilers will be used, if they can stand the test. It is expected that the new plant will be installed and in operation within 30 days.

EUGENE, ORE.—The $60,000 stock subscription required for the electric railway from Eugene to the mouth of the Siuslaw River, which is being promoted by Stephen Carver, has been secured among the people of Eugene and construction of the road is assured. It is proposed to organize a company with Mr. Carver as president, after which construction will begin. It is planned to build ten miles this summer and to complete the first 30 miles by next summer.

PANAMA.—Bids will be received by D. W. Ross, general purchasing officer, Isthmian Canal Commission, Washington, D. C., until Aug. 22, for furnishing direct-current dynamo and engine, switchboard, shop machines, governors, electrical fixtures, magneto batteries, wires, etc., as per circular No. 382.

FREEDOM, PA.—The Federal Telephone Company, of Pittsburg, which was granted a franchise in Freedom in 1900, has asked that its franchise be repealed, declaring it did not obtain enough subscribers to make the business pay.

GETTYSBURG, PA.—It is reported that negotiations are under way for the connection of the lines of the Washington, Frederick & Gettysburg Railway Company and the Great Falls & Old Dominion Railway Company by the construction of an electric railway 29 miles long.

HUNTINGDON, PA.—The Juniata Electric Street Railway Company is planning to build a railway from Huntingdon to Lewistown.

KITTANNING, PA.—Extensive improvements are contemplated by the new owners of the Kittanning Electric Light Company. Material has been ordered for a new transmission line from the power house at Garrett's Run to Market Street, where connection will be made with several of the company's circuits. It is not the intention of the company to abandon the Queen Street power house for the present at least.

LEMOYNE, PA.—The Valley Traction Company has entered into a contract with the York Haven Power Company to furnish electricity for operating its system after Aug. 1. Sub-stations will be built at Lemoyne and other places. When the sub-stations are completed the Lemoyne plant will not be operated, but will be held in reserve for emergencies. The transmission line has been erected from the York Haven plant to the Lemoyne station, but new machinery will have to be installed before power from the York Haven plant can be used.

PHILADELPHIA, PA.—Bids will be received by George R. Stearns, director of public works, until Aug. 29, for additional dynamos and pumps for the Torresdale filter plant. The bids call for three 150-kw generators to furnish electricity for lighting and driving the air blowers for the preliminary filters. Estimated cost is $25,000.

SCHUYLKILL HAVEN, PA.—The street lighting system of the municipal electric light plant is being changed to new enclosed arc lamps.

SLATINGTON, PA.—The right of way has been secured for the Franklin & Towamensing Street Railway Company from Slatington to Lehighton, a distance of nine miles, and work on the construction of the road will commence within two weeks.

RAPID CITY, S. D.—The Rapid City Electric & Gas Light Company is planning to change its system from single-phase to three-phase, 60-cycle, to establish a day service, and add another 120-kw direct-connected three-phase, 60-cycle alternating-current generator. The company has recently ordered a 200-hp Murray boiler, which when installed will give the plant 325-hp boiler capacity. A 100-kw, three-phase, 60-cycle alternator will be installed to take the place of the present 100-kw, single-phase, 133-cycle generator, and a direct-connected steam unit will also be installed.

HENDERSON, TENN.—At an election held recently the proposition to issue $10,000 in bonds for electric lights was defeated.

MEMPHIS, TENN.—The South Memphis Traction Company has applied for a charter to construct several new lines in South Memphis. K. D. McKellar and James F. Hunter are interested in the company.

NASHVILLE, TENN.—R. E. Chamber, of Cincinnati, Ohio, is interested in a proposition to build an electric railway to connect Louisville, Ky., with Nashville.

DENISON, TEX.—The Denison Light & Power Company has commenced work on improvements and additions to its plant, the cost of which is estimated at $40,000.

HANDLEY, TEX.—To meet the requirements of its increasing business the Northern Texas Traction Company has found it necessary to make another addition to the equipment of its power house at this place, machinery for which has been ordered.

HUNTINGTON, UTAH.—The Electric Light & Milling Company is preparing for the construction of an electric plant, and is now asking for bids for machinery. The plant, when completed, will furnish electricity for lighting Cleveland and Lawrence, as well as Huntington. William Howard is manager.

LURAY, VA.—The Page Valley Telephone Company has purchased a telephone franchise in this town for $25, with $25 annual franchise tax.

RICHMOND, VA.—Superintendent Bolling, of the Water Department, is reported to be in favor of installing an electric power and pumping station at the old pump house, to furnish electricity for lighting and pumping.

DAVENPORT, WASH.—The Washington Power Company is making arrangements to furnish electricity for lighting and power purposes in different cities and towns in Big Bend County. The company will operate under the name of the Big Bend Light & Power Company. The capital stock of the company is $300,000. Surveys are now being made for the pole line.

NEWPORT, WASH.—It is reported that work will soon commence on the water power development at Albeni Falls, two miles from Newport, and that the electric railroad between Newport and Spokane will be in operation within a year. The company, it is said, expects to develop about 30,000 horse-power.

PORT ANGELES, WASH.—Plans are being made to enlarge the electric light plant and to have it operated by water instead of steam power. Bonds have been issued to the amount of $80,000 for the work. The new plant is to have a capacity of 350 horse-power, but no specifications have been made as yet. John F. Hallahan is manager.

SEATTLE, WASH.—For the addition to the municipal water-power plant on Cedar River, R. H. Thompson, city engineer, has given a contract to the Westinghouse Electric & Manufacturing Company, Pittsburg, Pa., for two 4000-kw alternators, and to the Fort Wayne Electric Works, Fort Wayne, Ind., for 17 1500-kw transformers, to be used in connection with the 60,000-volt transmission line to Seattle.

ELKINS, W. VA.—Bids will be received by the County Commissioners until Aug. 26 for electric and gas fixtures for the court house now under construction. Lee Crouch is clerk.

CEDARBURG, WIS.—The Freistadt & Cedarburg Telephone Company has filed amendments to its charter increasing the capital stock of the company from $3,000 to $7,000. Joseph H. Klug is president.

GREEN BAY, WIS.—F. H. Joslyn, of Oshkosh, has petitioned for a franchise for an electric light plant.

MILWAUKEE, WIS.—It is announced from Spokane, Wash., that the Chicago, Milwaukee & St. Paul Railway Company is planning to install a series of hydro-electric plants on the St. Joe River, between North Fork and St. Joe, in Northern Idaho, east of Spokane, and utilize the electrical power developed for operating the railway across the Bitter Root Divide, and also for operating several sawmills and other plants. The work will cover 35 miles of the St. Joe River, and it is said that 180,000 horsepower can be developed. The work will cost $9,000,000 and will take three years to complete. It is stated that three dams are to be constructed at once, and others will be built later. The work is in charge of C. B. Price, a hydraulic engineer.

LANDER, WYO.—O. C. Lander, president of the Lander Irrigation & Improvement Company, writes that the company is erecting a hydro-electric power plant at this place and is in the market for 4300 feet of riveted pipe, turbines, generators, centrifugal pumps direct connected to motors having a capacity of 10,000 gallons per minute, with 60 feet head of elevation. The power plant has a 300-ft. head, with a supply of 9000 cubic feet of water per minute. J. C. Edsall is engineer.

GLACE BAY, N. S.—The Sydney & Glace Bay Railway Company has decided to locate its central power station and car house in this place.

GRAVENHURST, ONT.—The corporation is installing a 750-hp hydro-electric plant at South Falls to furnish electricity for light and power in Gravenhurst. W. W. Beall & Company are building a transmission line, including a telephone line, from the Falls to Gravenhurst.

ST. THOMAS, ONT.—The Ontario Railway and Municipal Board has approved the by-law providing for the issuance of $7,000 in bonds for the extension of gas and electric light systems.

New Industrial Companies.

THE ELECTRICAL CONSTRUCTION COMPANY, of Little Rock, Ark., has been incorporated with a capital stock of $25,000 by Richard Bragg, F. A. Bragg, A. D. McConnell and others. The company will sell electrical supplies and apparatus.

THE LEA EQUIPMENT COMPANY, of Camden, N. J., has been incorporated with a capital stock of $50,000. The incorporators are Edgar T. Earle, H. N. Earle and Albert G. Lea. The company will engage in electrical engineering.

Company Elections.

ATLANTA, GA.—The directors of the Georgia Railway & Electric Company have elected George Brine and T. K. Glenn directors to succeed Albert E. Thornton, deceased, and W. L. Cosgrove, resigned. Mr. Brine recently succeeded Mr. Cosgrove as president of the Atlanta Gas Light Company, and is vice-president of the Georgia Railway & Electric Company.

PITTSFIELD, MASS.—At the annual meeting of the Pittsfield Electric Company, held July 24, the following named officers were elected for the ensuing year: Alexander Kennedy, president and treasurer; William L. Adam, clerk, and W. A. Whittlesey, superintendent.

New Incorporations.

LOS ANGELES, CAL.—The Western Gas & Electric Company has been incorporated with a capital stock of $25,000 by F. O. Collins, J. N. Black, E. V. Reeves, S. S. Lawson and R. G. Roberts.

SAN FRANCISCO, CAL.—The Nevada Miners' Power Company has been incorporated with a capital stock of $1,000,000 by M. F. Remington, T. G. Roberts, J. Rutishauser, W. H. Davis and B. R. Reynolds.

SAN FRANCISCO, CAL.—The Stockton Gas & Electric Corporation has been incorporated with a capital stock of $1,500,000 by Paul McDonald, A. H. Winn, R. T. Hooper, H. F. Allen and J. T. Handy.

DENVER, COL.—The Summit County Power Company has been incorporated with a capital stock of $500,000 by John McConnelly and others.

WILMINGTON, DEL.—The Nicholas Power Company has been incorporated with a capital stock of $250,000 by R. C. Lupton and others.

PADUCAH, KY.—The Southern Construction Company has been formed for the purpose of building the interurban line from Mayfield to Paducah. The company is capitalized at $10,000 and the incorporators are B. H. Scott, H. H. Loving, John F. Harth, George Rush and others.

WILLIAMSBURG, KY.—The Williamsburg Electric Light Company has been incorporated with a capital stock of $5,000 by E. E., L. A. and L. Nelson, of Williamsburg.

BOSTON, MASS.—The E. Ericson Electric Company has been incorporated with a capital stock of $40,000 by Leonard Erickson, Frank M. Edmonds and B. F. Borhek.

DULUTH, MINN.—The Interurban Power Company has filed articles of incorporation with a capital stock of $100,000. The company proposes to generate electricity for all purposes and to furnish water to municipalities, and to construct and operate canals. The incorporators are: Charles C. Cokefair, Francis A. Cokefair and William Harrison.

ALLIANCE, OHIO.—The Youngstown, Alliance & Akron Railway Company has been incorporated with a capital stock of $10,000 by T. H. Given, of Pittsburg, Pa.; M. K. McMillin, of Pittsburg, Pa.; E. H. Brosius, Hugh Blakeley and R. S. Kayler, of Alliance.

CLEVELAND, OHIO.—Articles of incorporation have been filed for the Toledo & Fort Wayne Electric Railway Company with a capital stock of $10,000. The incorporators are E. J. Pinney, H. J. Nord, Lewis A. Goldstein, Thomas C. Willard and others.

HARRISON, OHIO.—The Harrison Electric & Water Company has been incorporated with a capital stock of $30,000 by William F. Boyd, Edward Avesmer, Samuel L. Farland and others, to acquire and operate the electric and water plant in Harrison and West Harrison.

CHEROKEE, OKLA.—The Cherokee Light, Ice & Power Company has been incorporated with a capital stock of $50,000. The incorporators are: E. T. Carpenter, J. W. Howard, A. H. Stout, A. J. Titus and Luther Martin.

Obituary.

MR. THOMAS ARTHUR LAWRENCE, chief meter tester for the Edison Electric Company, of Brooklyn, N. Y., died Aug. 7, at his residence, 484 Jefferson Avenue. He was born Dec. 18, 1883, and was the son of Francis M. and Amanda M. Lawrence, who survive him, together with three brothers and two sisters.

Personal.

Mr. T. I. Jones.

MR. THEODORE INSLEE JONES has recently been appointed manager of the sales department of the United Electric Light & Power Company, of New York City. In this position he will have full charge of the sales end of the United Company's business, including all contracts for electric light, power, heat and sign work, together with the company's advertising. Mr. Jones is an electrical engineer, graduating from the Massachusetts Institute of Technology in the class of 1896. Immediately after graduating he took a position with the American Telephone and Telegraph Company in its New York office. In this position he identified himself with the work of the inspection and traffic departments, originating and equipping in connection with Assistant General Superintendent Brooks, of that company, the first school of instruction for employees engaged in telephone traffic, which has since become an important adjunct of all telephone companies' work. After four years' experience with the American Company, Mr. Jones took up similar duties with the New York & New Jersey Telephone Company in its New Jersey division, where he had charge of the traffic department. While engaged in this work, Mr. Jones prepared and delivered a course of lectures on telephone and electric light topics for the evening branch of the New York Board of Education, which he has continued each year up to the present time; last year giving two courses, one on telephone engineering and one on illuminating engineering. The early part of the present year, Mr. Jones accepted a position as illuminating engineer with the Nernst Lamp Company in its New York district, and when in this position was offered the managership of the sales department of the United Company, the duties of which position he is now entering upon. Mr. Jones is the author of a number of articles on electrical topics, among them being: "A Study of the Efficiency of the Electric Light Plant of the Boston Public Library," "Notes and Suggestions for the Instruction of Employees Engaged in Telephone Traffic," "The Progress of the Telephone," "Five Papers on Illumination Engineering." The new sales manager will make his headquarters at the general offices of the United Company, 1170 Broadway.

Mr. Avery P. Eckert.

MR. AVERY P. ECKERT, long and well known in the electrical field, has just resigned from the Safety Insulated Wire & Cable Company, to become general sales manager for the Duplex Metals Company, of Chester, Pa., with office headquarters in the Lincoln Trust Building, 208 Fifth Avenue, New York City. Mr. Eckert, who is one of the younger members of the famous electrical family bearing the name, began his career with the old Metropolitan Telephone Company—now the New York Telephone Company—with which he spent six years, gaining technical experience in practically every department. He then spent three years with the Kerite Company, and for the past fourteen years has been very actively identified with the Safety interests. For several years he served also as the efficient secretary of the Electrical Trades Society of New York. He is therefore in many ways a man with ideal qualifications for introducing the remarkable specialty known as the Monnot wire, which with other forms and shapes of combined steel core and copper sheathing, is being manufactured by the Duplex Metals Company. Few of our readers have an idea of the wide range of application within and outside the electrical field that has already been found for the Monnot process, now a well tried and proven advance. Wire of this description has been on the market long enough so that comparative tests have been made to determine its feasibility for telephone lines. The breaking strength of No. 17 copper clad wire, as this new wire is called, and No. 14 new British standard copper wire is the same—190 lbs.—but the weight of No. 14 solid copper wire is 65 lbs. per mile, while that of the No. 17 copper clad wire is 29 lbs. This effects no inconsiderable saving, not only because of the weight of the wire itself, but the new wire being partially composed of steel is cheaper per pound. The saving in poles and cross arms is also a large item and one which will increase with the greater cost of poles. A series of comparisons has been made by the Duplex Metals Company, which shows that with the net cost of a mile of No. 14 solid copper wire at $47.90, the cost of No. 14 copper clad wire under the same conditions is $33.79, which shows a saving of $14.11 per mile for wire having a conductivity sufficient for the requirements. This process of welding metals is not only applicable to iron and steel, but to other metals as well. The Westinghouse Machine Company has taken up the material exclusively for steam turbine blades, for which it has extraordinary recommendations. In short, there is work enough ahead to keep Mr. Eckert extremely and indefinitely busy, and a host of friends all over the country will watch with great pleasure his effort and success.

MR. ABRAHAM WHITE, it is stated, is leaving the United Wireless Telegraph Company, organized last November, with the idea of consolidating the Marconi and De Forest wireless systems.

MR. H. R. HUME, formerly manager of the gas engine department of the Fairbanks Company, Pittsburg, is now connected with the Switchboard Equipment Company, of Bethlehem, Pa., as sales manager.

MR. CLARENCE H. MACKAY, president of the Mackay Companies, sailed last week for Scotland, to be gone some little time, but Mrs. Mackay stays behind and is taking part in the social gayeties of Lenox, Mass.

MR. P. G. WATMOUGH, JR., consulting electrical engineer, 59 Pearl Street, New York City, has been engineer for the lighting installation now near completion, put in by the famous old Seamen's Savings Bank on Wall Street.

MR. WILLIAM E. MITCHELL, formerly with the Sao Paulo Tramway Light & Power Company, has accepted a position as electrical engineer of the Bahia Tramway, Light & Power Company, of Bahia, Brazil, which has taken over the old Siemens & Halske electric tramway, and is completely renovating and extending the system.

MR. H. R. BAILEY, in charge of the electrical work of the New York and Long Island Railroad Tunnel (under Forty-second Street, New York and East River) was presented with a handsome gold watch and chain last Monday. The gift is the expression of the feeling cherished by the men under his direction in the electrical department of the work.

MR. W. J. MEYERS.—Mr. William J. Meyers has been appointed Chief of the Division of Statistics and Accounts for the New York Public Service Commission in the Second District, at a salary of $5,000. Mr. Meyers is now assistant to Prof. Henry C. Adams, Chief of the Division of Statistics and Accounts of the Inter-State Commerce Commission.

MR. E. J. RICHARDS, superintendent of the electrical department of the Newburgh Light, Heat & Power Company of Newburgh, N. Y., has resigned his position to take effect Sept. 1. Mr. Richards will take a similar position with a light and power company in New Orleans, La. Mr. Richards has rendered valuable service to the local company since his connection with it, and has been largely instrumental in bringing about modern methods which have been introduced in the distribution of electricity for lighting and power purposes throughout the city and adjacent territory. He will take with him to New Orleans the best wishes of many Newburgh friends.

MISS JESSIE MAY HAZELRIGG, eighteen years old, daughter of Mr. and Mrs. Scott F. Hazelrigg, of Tompkinsville, S. I., has been chosen Queen Titania VII., to rule at Asbury Park, N. J., over the events of Carnival week, Aug. 23 to 30. Miss Hazelrigg's summer home is at No. 708 Seventh Avenue, Asbury Park. She is a graduate of Hollins Institute, Virginia, and is a close companion of her father, who is vice-president and general manager of the Richmond Electric Light & Railroad Company of Staten Island; president of the Atlantic Coast Electric Railway, Asbury Park; president of the Midland Beach Railway, and is connected with several other railway enterprises.

MR. JOHN C. OSTRUP, M. Am. Soc. C. E., has been appointed to fill the Chair of Structural Engineering at the Stevens Institute of Technology, Hoboken, N. J. Prof. Ostrup is a graduate of the Polytechnic School in Copenhagen, and later took a post-graduate course at the Chicago Engineering School, and has had a large and varied experience in important work extending over 17 years. He was for five years in charge of the office work and design of the Lake Street, the Northwestern and the Union Elevated railroads in Chicago during their construction, and afterwards designing engineer of the Boston Elevated Railroad during its building. Upon the completion of this he went into private practice for four years, and has designed many important structures and bridges for the American Bridge Company of New York.

MR. R. L. DEAN.—Mr. Robert L. Dean, president and electrical engineer of the Dean Rapid Telegraph Company, of Kansas City, is at the Waldorf, New York. His system has been in actual operation between Kansas City and St. Louis for about two months past transmitting daily business telegrams and press matter for newspapers. Mr. Dean's object in coming to New York at this time is to purchase additional equipment to further extend his system. He proposes to enlarge operations so as to reach various important points throughout the country, employing existing independent telephone lines. It is said that the Dean rapid telegraph system maintains a speed of 350 words a minute over a phantom circuit between Kansas City and St. Louis, in connection with a long-distance telephone line in constant use.

MR. EDGAR C. BRADLEY has been elected vice-president and general manager of the Pacific Telephone & Telegraph Company. According to officials of the company the change has no special significance. President Scott still retains his official title, although yielding practical direction of affairs to the new officer. Mr. Bradley does not displace any one, but becomes a third vice-president, the other two being Louis Glass and E. J. Zimmer. His connection with the American Bell Telephone parent company, it is stated, has been severed and he will henceforth devote himself solely to the local company. Mr. Bradley was formerly third vice-president of the Postal Telegraph Company. He resigned that place to become assistant to F. A. Pickernell, who was assistant to the president of the American Telephone & Telegraph Company. His duties, it is understood, were a general supervision of the subsidiary companies embraced in a certain district and he went to San Francisco in pursuance of those duties.

Trade Publications.

THE SPRAGUE ELECTRIC COMPANY, of New York City, is mailing to the electrical trade and architects an attractive eight-page circular describing in detail new types of galvanized and enamelled stamped steel boxes and covers, and box fittings.

PITTSBURG TRANSFORMER COMPANY, of Pittsburg, Pa., has issued for August a very interesting folder relative to transformer behavior under, and results following, strokes by lightning. It is well worth reading. It also issues a pretty August calendar.

INSULATOR SUPPORTS.—The Electric Controller & Supply Company, Cleveland, Ohio, has issued a very neat little illustrated pamphlet as to its "Universal" insulator supports made under the McFeater patent. These are ingenious appliances specially devised for wiring in steel frame work of all kinds. No wood is required, and no holes need be drilled.

"BUSY."—The New York Telephone Company has issued a neat little brochure as to the manner in which a telephone subscriber by the addition of one or two extra lines can reduce the "busy" reports on his service to the minimum, and thus avoid blockade of business. Data are given of the subject from actual installations.

THE SPRAGUE ELECTRIC COMPANY, 527-531 West 34th Street, New York City, has recently issued a handsomely printed new bulletin, No. 507, treating of flexible-armored hose for steam or compressed air. This hose is adapted for the transmission line in drilling or chipping, and is extensively used by railway companies for air brake and signal line work.

THE TRUMBULL ELECTRIC MANUFACTURING COMPANY, of Plainville, Conn., has recently published a new bulletin of its type "A" switches, which shows a large extension to the line. Many changes and improvements are made. The bulletin covers 34 pages, and represents a most complete line of switches. Four-pole switches are listed, also new Code fused switches with high fingers for fuses, both on the hinge and the handle end, and a complete line of switches for alternating current from 15 to 2000 amperes. The bulletin will be gladly sent upon request to all those interested.

MOTOR DRIVEN PUMPS.—The Luitwieler Pumping Engine Company, Los Angeles, Cal., has issued a catalogue dealing with its non-pulsating pump. It is claimed that the efficiency of the pump is unusually high on account of the entire absence of back lash and water hammer. The pump is provided with two cylinders, each of which is driven through a cam mechanism from a shaft running at constant speed. The cams are of such design that they move the cross heads and the piston at a fixed rate of speed, and just before one cam reaches the end of its travel the other cam takes the water load and moves it along as before. Thus there are no dead centers and no periods of rest, and the water is delivered in one pulseless volume.

A MESSAGE FROM THE GOVERNOR.—This is the title of an illustrated brochure gotten out by the Holyoke Machine Company of Worcester, Mass. The cover design is particularly attractive, being in legal form, tied with ribbon and with seal attached. The publication describes the company's improved governor for water wheels, and points out its advantages. The governor has now been on the market five years, and during that time has been well tried under all conditions. The friction clutches which operate the water-wheel gates are thrown in and out of engagement by a hydraulic piston into which water or oil is admitted under a pressure of 25 to 30 lbs., by a valve on top of the cylinder; the valve being operated by governor weights in the driving pulley.

BRISTOL PYROMETERS.—Prof. W. H. Bristol, 45 Vesey Street, New York, has just issued Catalogue No. 17, in large quarto size. It contains a general description and a classified price list of the different groups and styles of his beautiful low resistance pyrometers, for both indicating and recording all ranges of temperature up to 3000° Fah. Prof. Bristol has also included in the catalogue illustrated descriptions of several ways in which the instruments can be applied in commercial service. A long list of names is given of users of these instruments, covering a wide range of industrial application. Copies of this very interesting catalogue, which is practically a short treatise on thermo-electric pyrometry, can be obtained on application. The large size is favorable to the exact reproduction of the curve charts reproduced of records taken by the instruments.

WARD LEONARD.—The Ward Leonard Electric Company has issued a catalogue, No. A-12, covering self-starters, showing its ALS type, comprising a self-closing switch, a self-starting rheostat provided with no-voltage and overload release and protective interlock, preventing the automatic closure of the self-closing switch, except when the rheostat is in its initial position. It is controlled by two push buttons—a starting push button and a stopping push button. The resistance is in the form of Ward Leonard enamelled resistance units. It also shows its AS type self-starting rheostat with plain no-voltage release, for use in connection with Ward Leonard self-closing main line switch or float switch, etc. The resistance of this type is also of Ward Leonard enamelled resistance units. In either case it is simply necessary to close the circuit and the machine does the rest. This catalogue is complete with specifications covering the features of design.

THE AMERICAN INSTRUMENT COMPANY, Philadelphia, Pa., has just published a new catalogue, No. 65, and is distributing it to the users of electrical measuring instruments. It is beautifully printed, profusely illustrated with half-tones, and deals in a very comprehensive way with their complete line of high-grade instruments of both switchboard and portable types. The valuable improvements found in "American" instruments are interestingly set forth, emphasis being placed on the interchangeability of the shunts and multipliers, and the excellent magnetic shielding qualities of the drawn soft steel cases used on switchboard types. Complete lines of round pattern and "long-scale" switchboard voltmeters and ammeters are listed with full data as to range and prices. Numerous diagrams give the dimensions required for drilling switchboards, etc. The well-known "American" portables are shown in the latter half of the book, together with a new line of standard voltmeters and ammeters for the most exacting laboratory work. Portable relays and galvanometers are also illustrated. Throughout the catalogue 65 is quite in keeping with the high-grade instruments it describes and illustrates. It is up to date, and contains 56 pages of useful instrument data. Every engineer should have a copy and keep it for handy reference.

Business Notes.

THE DOUBLEDAY-HILL ELECTRIC COMPANY, of Pittsburg, Pa., has opened a branch office in Charlotte, N. C., where a distributing house will be maintained.

ARROW ELECTRIC COMPANY.—Owing to the similarity of the names of the Perkins Electric Switch Manufacturing Company, of Bridgeport, Conn., and of the Perkins Corporation, of Hartford, Conn., and the confusion which naturally arises from that similarity, it has been decided to change the name of the Perkins Corporation to the Arrow Electric Company, and to change the trademark from "Arrow P" to "Arrow E." This change has now been effected, and the Arrow Electric Company assumes all liabilities of the Perkins Corporation.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED AUG. 6, 1907.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

862,127. CENTRIFUGAL SWITCHING DEVICE; C. B. Auel, Wilkinsburg, Pa. App. filed Dec. 3, 1906. A centrifugal switching device for limiting the speed of dynamo electric machines or motors in case the field strength is abnormally reduced by any accident.

862,135. AUTOMATIC TROLLEY RETRACTING MECHANISM; Henry B. Clarke, Highland Park, Ill. App. filed March 1, 1906. Relates to an improved automatic trolley retracting system of the type having a spring reel, and means for actuating the same to pull down the pole when the trolley wheel leaves the wire.

862,146. ELECTRICALLY-HEATED SHAFT FURNACE; J. S. Edstrom, Vesteras, Sweden. App. filed March 30, 1906. In an electric furnace the combination of a shaft, a hearth forming an annular horizontal chamber of a uniform or substantially uniform cross-section for taking up the melted material and placed directly beneath the shaft and an iron core for inducing electric currents in the said melted material, substantially as and for the purpose set forth.

862,159. TROLLEY; A. Hill, Lynn, Mass. App. filed March 2, 1907. Patentee has specially constructed a trolley-pole with a hinged section at its upper end which moves to trip and drop the pole when the wheel leaves the wire.

862,168. SYSTEM OF CONTROL FOR ELECTRIC MOTORS; H. D. James, Pittsburg, Pa. App. filed Nov. 13, 1905. A system of contactors for an induction motor by which resistance may be gradually and automatically removed from the secondary circuit as the speed increases.

862,191. TROLLEY WHEEL; P. M. Orlopp, Indianapolis, Ind. App. filed July 12, 1906. The trolley wheel has double springs for spokes so as to be resiliently supported.

862,192. CONTROLLING MEANS FOR ELECTRIC MOTORS; W. A. Paris, Edgewood Park, Pa. App. filed Dec. 4, 1905. An automatic controller for an electric motor designed to work through predetermined limits of movement as in operating a gate valve.

862,209. ELECTRIC SIGNAL SYSTEMS; A. L. Sohm, Los Angeles, Cal. App. filed Sept. 22, 1906. Provides an electric system in which signals or calls from any number of stations are indicated by figures corresponding to the number of digits by which the stations are indicated.

862,211. INSULATOR-SUPPORT; Wm. Steiner, Muskegon, Mich. App. filed March 24, 1906. A frame for grouping insulators around a base. The frame is built up in quadrants organized together by supporting bolts.

862,225. AUTOMATIC TEMPERATURE-REGULATOR FOR REVOLUBLE DRYING APPARATUS; H. F. Westphal, Milwaukee, Wis. App. filed April 7, 1906. Means for automatically regulating the temperature of a drying apparatus, particularly for grains, etc. Has a vessel filled with liquid and a diaphragm connected to the circuit closing device.

862,226. MOTOR-REGULATOR; G. H. Whittingham, New York, N. Y. App. filed July 16, 1903. Electro-mechanical means for controlling and regulating the starting and operation of electric motors.

862,272. FIELD REGULATORS FOR DYNAMOS; G. S. Neeley, St. Louis, Mo. App. filed June 18, 1906. A voltage regulator for alternating current generators adapted to automatically maintain a constant voltage in the circuit regardless of the demands for current.

862,273. VOLTAGE REGULATOR FOR DYNAMO ELECTRIC MACHINES; G. S. Neeley, St. Louis, Mo. App. filed Nov. 30, 1906. Relates to modifications of the above.

862,274. VOLTAGE REGULATOR FOR DYNAMO ELECTRIC MACHINES; G. S. Neeley, St. Louis, Mo. App. filed Nov. 30, 1906. Relates to modifications of the above.

862,277. SPRING FOR TROLLEYS AND HARPS; R. E. Noble, Chicago, Ill. App. filed Jan. 13, 1905. A spring for trolley harps, comprising a bent strip of spring metal having a loop at one side and having perforations adapted to engage with the pin or axle of the trolley harp.

862,329. SPARKING DYNAMO AND GOVERNOR; A. P. Griebel, Woodstock, Ill. App. filed Sept. 11, 1906. A spark dynamo for use with gasoline engines designed to have a constant speed by varying frictional connection with the engine fly-wheel.

862,333. METHOD OF CREATING A VACUUM; P. C. Hewitt, New York, N. Y. App. filed July 1, 1904. The method of creating a high vacuum in an inclosed chamber, which consists in introducing aluminum and mercury so that they amalgamate and absorb gases.

862,361. ELECTRICAL APPARATUS; W. H. Thompson, Wilkinsburg, Pa. App. filed July 17, 1905. A means for varying the strength of magnetization of an iron core which has parts thereof in the form of rollers from which flexible magnet wire can be wound from one to another.

862,380. ADJUSTABLE BOX FOR SWITCHES AND THE LIKE; M. D. Baron, New York, N. Y. App. filed Feb. 24, 1906. Relates to wall boxes for use in house wiring. Provides a complete fireproof inclosure for electric connections in conduits in the wall of a building.

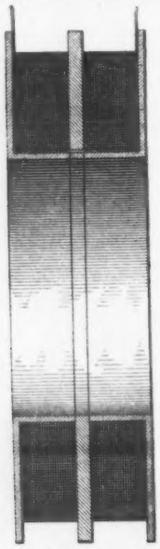
862,397. ELECTRIC-LIGHT CLUSTER; L. Hruska, Chicago, Ill. App. filed March 25, 1907. A multiple cluster socket for incandescent lamps having a swivel connection with a supporting base so as to be removed without disturbing the circuit connections.

862,402. PRINTING TELEGRAPH; C. L. Krum, Chicago, Ill. App. filed Oct. 6, 1904. Complete electrical and mechanical features of a printing telegraph machine.

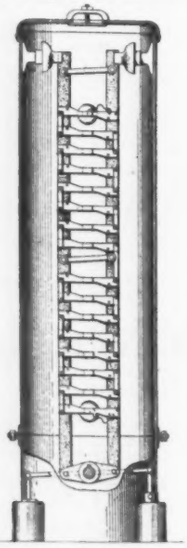
862,409. TREATING SHEET METAL BY ELECTROLYSIS; J. Muller, Austria-Hungary. App. filed April 18, 1906. The herein described process of electroplating a plurality of individual sheets or plates, which consist in temporarily connecting the edges of said plates to form a continuous band and then passing the band continuously through the electrolyte, substantially as described.

862,423. TELEGRAPHIC TRANSMITTER FOR THE MORSE SYSTEM; T. C. Van de Stadt, Aardenburg, Netherlands. App. filed April 2, 1907. A typewriter or keyboard transmitter for telegraph systems having inset conductors in a revolving cylinder which are engaged by brushes.

862,441. ELECTRIC CONTROLLING SYSTEM; C. P. Breese, Norfolk, Va. App. filed Aug. 11, 1902. A block signal system for electric trolley roads having a sectional trolley conductor and relay magnets operated by the passage of current thereto from the mains.



862,506.—Induction-coil Unit.



862,513.—High-potential Circuit Breaker.

862,442. ELECTRIC CONTROLLING SYSTEM; C. P. Breese, Norfolk, Va. App. filed Aug. 11, 1902. Relates to modifications of the above.

862,444. WIRE HOLDER; S. J. Brund, Cottage Grove, Ore. App. filed April 16, 1907. An insulating support for telephone wires having two horizontally journaled grooved rollers between which the conductor is led.

862,449. HOOK-SWITCH; E. B. Craft, Chicago, Ill. App. filed April 9, 1906. A hook-switch comprising a mounting plate, a lever pivotally supported upon the rear of said plate and projecting through an opening therein, a finger carried by said lever behind said plate, and switch springs supported upon the rear of said plates, one of said springs projecting beyond the remaining springs into position for operation by said finger to actuate said springs, said spring forming a restoring spring for said lever.

862,497. HOLDERS FOR TELEPHONE RECEIVERS; W. J. Mogridge, Spokane, Wash. App. filed Nov. 16, 1906. Attachment for ordinary desk 'phone by which receiver can be supported at ear when talking into transmitter.

862,506. INDUCTION-COIL UNIT; Carl A. Pfanstiehl, Highland Park, Ill. App. filed Dec. 27, 1906. Comprises a pair of outer spool heads formed with central orifices and annular necks which project towards each other. An intermediate head is formed with a corresponding orifice and a small passage adjacent to the orifice.

862,513. HIGH-POTENTIAL CIRCUIT BREAKER; Laporest G. Robinson, Pittsburg, N. Y. App. filed Dec. 12, 1905. Comprises a pair of insulating bars, a rocker arm for supporting the bars and imparting a relative motion thereto, and two series of contact springs, respectively joined to the bars so as to break contact with one another when the bars are moved.

862,520. ELECTRICAL ROSETTE; James S. Stewart, New York, N. Y. App. filed July 21, 1906. Provides a positive and unyielding abutment to receive the strain on the depending extension walls from a rosette. Has other features, including a casing of stone or enameled iron ware which is strong and light and insulating in character.

862,532. ELECTRIC TRANSFORMER; Isaac Anderson (2), Tacoma, Wash. App. filed April 29, 1907. The core of the transformer has air gaps therein through which air may be circulated to keep the transformer cool.

862,542. CABLE-TERMINAL AND SYSTEM OF PROTECTION; F. B. Cook, Chicago, Ill. App. filed Jan. 18, 1906. A cable terminal, a circular base therefor to which the terminal is mounted, suitable vertical brackets secured to the said base and adapted to be secured around the top of a pole, and suitable holes in the said base spaced so as to give the said brackets various mountings to enable them to fit different sizes of poles.

862,543. CABLE TERMINAL; F. B. Cook, Chicago, Ill. App. filed May 28, 1906. Modifications of above.

862,551. VALVE APPARATUS; J. H. Gardner, Newport, R. I. App. filed July 18, 1906. Relates to valves through which a fluid is supplied, and means for operating an indicator or alarm when said valve is open or partially open, the alarm being inoperative when the valve is closed.

862,580. RELAY; F. R. McBerty, New Rochelle, N. Y. App. filed July 16, 1906. The combination with a magnet, of an armature therefor, an adjustably-mounted screw having an unthreaded end portion passing through said armature to prevent the same from being unseated, and a shoulder on said end portion acting as a stop for said armature.

862,582. TROLLEY SWITCH FROG AND POLE; A. Neubert, Elizabeth, N. J. App. filed Feb. 15, 1906. The trolley switch frog has a pair of laterally projecting rollers which slide on the under surface of flat plates adjacent the trolley wire at a fork or turnout.

862,589. AUTOMATIC ELECTRIC SIGNALING DEVICE; A. J. Roy, Providence, R. I. App. filed March 9, 1906. A semaphore signal positioned by a circuit which is closed by a mechanical tappet adjacent the track rail.

862,616. TELEPHONE SYSTEM; W. W. Dean, Chicago, Ill. App. filed Sept. 3, 1901. The combination with a telephone line, of a line relay, a signal controlled thereby, a battery in the line, a jack for the line, and a cut-off relay adapted to be connected in a bridge of the line between the line relay and the jack and to open said battery connection when a conversational circuit is established with the line.

862,618. COUPLING FOR LEAD-COVERED ELECTRIC CABLES; J. J. Dossert, New York, N. Y. App. filed Jan. 19, 1904. A means for joining together stranded cables used in underground work so as to make a properly conducting insulated waterproof joint.

862,660. ROSETTE FOR ELECTRICAL WIRING; W. F. Ritter, Cincinnati, Ohio. App. filed Oct. 28, 1906. A rosette formed of insulating material with an opening for the passage of a circuit conductor and surrounded by an enlarged socket on the rear face of the rosette.

862,701. TROLLEY WHEEL; W. H. Bradt, Schenectady, N. Y. App. filed Dec. 5, 1906. A trolley wheel made of two halves spring pressed together to make better contact with the wire.

862,713. TELEPHONE EXCHANGE SYSTEM; M. S. Conner, Rochester, N. Y. App. filed May 28, 1904. Complete diagram multiple exchange circuit.

862,723. ANNUNCIATOR SYSTEM; W. E. Ebert, St. Louis, Mo. App. filed May 19, 1906. Mechanical construction of annunciator in a hemispherical casing having a target member pivoted coaxially with the casing.

862,740. ELECTRIC CONTROLLING DEVICE; M. Kallmann, Berlin, Germany. App. filed June 1, 1905. Features of a Wheatstone bridge apparatus having novel features.

862,758. INSULATOR; A. A. Pratt, Los Angeles, Cal. App. filed Oct. 25, 1906. Construction of insulator having a transverse opening through which passes a conducting rod held in the insulator by insulating conical bushings.

862,776. DYNAMO-ELECTRIC MACHINERY; W. L. Waters, Milwaukee, Wis. App. filed Dec. 9, 1905. Construction of a squirrel-cage armature for induction motors.

862,781. ELECTROTHERAPEUTIC APPARATUS; L. G. Woolley, Lima, Ohio. App. filed May 28, 1906. A therapeutic apparatus having a vessel or tank which can be applied to the desired portion of the body so as to supply current thereto.

862,783. ELECTROLYTIC CELL; E. A. Allen, Rumford Falls, Maine. App. filed July 17, 1905. An electrolytic cell for aqueous solutions comprising a tank having decomposing and oxidizing compartments, a mercury cathode therein, an anode in the decomposing compartment, a return-flow conduit for amalgam extending between opposite portions of said tank, and means for imparting heat to the amalgam in said return flow conduit.

862,842. RHEOSTAT; E. F. Northrup, Philadelphia, Pa. App. filed May 3, 1907. A rheostat having a circular grooved block in which is contained a spiral resistance element over which swings a contact arm pivoted coaxially with the block.